

State of New York



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Despite impressive achievements over the past decade in restoring the region's mass transit network after years of neglect and deterioration, serious problems in the Metropolitan Transportation Authority's Capital Program require corrective actions, according to a study issued today by MTA Inspector General John S. Pritchard III.

The report, "A Review of the Metropolitan Transportation Authority's Capital Program," focuses on the efforts of the New York City Transit Authority (TA), the Long Island Rail Road (LIRR) and the Metro-North Commuter Railroad to upgrade their facilities and to complete construction projects on time and within budget. In addition to a series of findings on each agency's individual progress, the report contains a number of recommendations for correcting the deficiencies noted.

"Clearly the MTA's 10-year \$16.5 billion Capital Program has significantly improved service," the Inspector General said. "Trains and buses are cleaner, more reliable and safer than they were 10 years ago."

"I am concerned, however, that the MTA is not where it expected to be by now," Pritchard continued, "and that many projects had to be deferred because funds were needed to cover rising costs in other projects."

In the review, Pritchard pointed out that in November 1980 when then-MTA Chairman Richard Ravitch called for a capital program to restore the decaying system to a state of good repair, the MTA estimated it would take ten years and cost \$14 billion.

"That projection proved to be extremely optimistic," Pritchard said. "The MTA now says it needs \$10.6 billion more, and admits that additional funds will be needed well into the 21st century."

The Inspector General's study found that the TA's efforts to restore its facilities and equipment to a state of good repair has achieved mixed results. While the TA has restored its buses, subway cars and mainline track, its timetable for repairing its stations, shops, yards, line equipment and signals has slipped substantially.

(more)

The TA now estimates that its stations will not be in a state of good repair until 2009, 16 years later than the original goal set in 1983. Shops will not be finished until 2006, 18 years later; yards until 2015, 21 years later; tunnel fans until 2007, 14 years later; and signals will not be finished until 2012, nine years later than originally set.

"The TA's failure to reach its goals for achieving a state of good repair is quite troubling," the Inspector General said. "And our careful analysis of the extent of work done over the past decade calls into question some of the schedules now being proposed, especially for stations, line equipment and signals."

As explained in the study, one reason for the TA's inability to achieve all it set out to is that increasing program costs and changing priorities eroded what existing funds could accomplish. Consequently, many improvements which were originally part of the TA's 1987-91 Capital Program were deferred. Among these projects were six of ten yard rehabilitation projects, two of four "key" station modernizations, three of six depot construction projects, three of 11 depot rehabilitation projects, nine of 33 fan replacement projects and the rehabilitation of the TA's 207th Street subway car maintenance facility.

"The cost increases responsible for these deferrals did not occur because of construction overruns," Pritchard said. "They were the result of initial underestimation of project costs, and increasing design, construction administration and TA labor costs. These are the type of cost increases the TA must control."

The report also found that priorities and resources changed during both the 1982-86 and 1987-91 Capital Programs because of the TA's failure to compile complete and accurate information regarding the condition of its facilities and equipment. As a result, to meet unexpected needs, funds had to be shifted to track, stations and line equipment projects at the expense of shops, yards, signals and depot projects.

Specifically, the review noted that during the first Capital Program the TA was caught off guard when it discovered that its track was in far worse condition than originally thought. While \$365 million was initially budgeted, following a systemwide emergency inspection, the TA was forced to shift over \$225 million from other projects to accelerated needed track work.

"Unfortunately, however, the lesson didn't sink in, and what happened at the Nevins Street station proves that," the Inspector General said. The report explains that the TA had planned to spend \$458 million on stations during its 1987-91 Capital Program, but failed to first determine whether any of its stations suffered from structural defects. Consequently, when TA management finally reviewed the structural condition of its 469 stations in 1989, it was confronted with some severe structural problems.

For example, engineers found the Nevins Street station to be "beyond repair" and that safety would be "compromised" if major rebuilding was not done immediately. Although they urged the TA to conduct structural integrity tests, none were. It was only when more problems were discovered in 1990 that the MTA took the problem seriously, declared Nevins Street an emergency, and approved \$10 million in repairs.

The lack of adequate information and planning also adversely affected plans to upgrade tunnel fans and has substantially raised the cost of the Automated Fare Collection (AFC) project. From 1982 to 1991, for example, the TA's policy with regards to fans was to replace them as required, resulting in a struggle just to keep its almost 300 antiquated fans operating. Following the December 1990 Clark Street tunnel fire, however, TA management decided to examine its tunnel ventilation network and design a rational system based on national safety standards.

Similarly, while the TA's 1987-91 Capital Program included a number of projects which required tapping into the station power supply, it was undetermined as to how much electricity could actually be supplied. Consequently, in 1984 when the TA started to test the AFC equipment, it expected the total program cost to be only \$80 million, when in actuality, the need for bringing in more power added \$250 million to the total AFC project cost.

"While I recognize that certain problems facing the Capital Program, such as delays in funding or new mandates, are not within the direct control of management," Pritchard said, "checking the condition of assets before setting priorities and planning specific projects certainly is.

"Failing to do this not only jeopardizes the success of the program, but more importantly, it can threaten the reliability and safety of subway, bus and commuter rail operations, as well.

"It should not have taken a tragedy at Clark Street to get a comprehensive plan for tunnel fans started. It should not take a near-collapse of Nevins Street to focus attention on how many other stations may have corroded steel or weakened concrete behind walls or ceilings," Pritchard continued. "If anyone wants to know why we concentrated so much on achieving a 'state of good repair,' let them consider these two recent events and how they affected and continue to affect millions of daily commuters."

The Inspector General's review also questioned the TA's justification for spending over \$700 million for AFC and associated improvements. While the TA estimated that the project would raise revenues from \$66 million to \$106 million per year, the report concluded that there was little support for this projection.

Specifically, two-thirds of the projected increase (\$41 million) is expected to come from curbing fare beaters, a conclusion reached by TA management after extrapolating information from a two-month test at only one subway station.

Other estimates for new revenue came from studies of the effect of past fare increases. However, even TA analysts questioned whether it was appropriate to use these studies to project increased revenue of \$10 million to \$50 million, citing "inconclusive and counter-intuitive results."

"The MTA and its agencies must do a better job of calculating the benefits its new initiatives are expected to produce and the full costs of achieving them," Pritchard said. "Especially now, in a time of severe budget cuts at every level of government, policy-makers cannot afford to make decisions based on faulty or incomplete information."

The study also provides a comprehensive overview of work planned and completed during the first two Capital Programs at the MTA's commuter railroads. In general, it concluded that Metro-North has experienced far fewer delays and major problems than either the LIRR or the TA.

"The commuter railroads are in better shape than the TA, but they also have a long way to go," the report states. Metro-North's track, cars and signals will be in good repair by 1996, but its power system, shops and yards, stations and line structures will not be. The LIRR's cars, tracks and power equipment were in good repair by the early 1980s, and its shops, yards and signals will meet that goal in 1991. Its stations, however, will take until 1995 and work on its line structures will not be completed until 2011.

Other definite and significant problems were experienced by the LIRR. For example, much of its 1987-91 Capital Program was affected by frequent funding shifts resulting from cost overruns and changing priorities. Many of these shifts were due to rising costs of the Hillside Maintenance Complex, the largest single LIRR project. Budgeted at \$173 million in 1983, this massive facility, which opened this past summer, ultimately cost \$381 million.

Primarily as a result of Hillside and the effect it had on other projects, the federal government in 1989 held up funding at the LIRR until the railroad could demonstrate that it was in control of its construction program.

"New procedures were put into place which should prevent this from happening in the future," the Inspector General said, "but this shows what can happen when hundreds of millions of dollars are spent without adequate project scopes and costs estimates, without thorough condition surveys, and when frequent changes in top management lead to constant changes in program priorities."

At Metro-North, the report found that its \$1.7 billion Capital Program generally has been well-managed. Few projects had significant delays or cost substantially more than budgeted. In fact, in certain cases, projects were completed well ahead of schedule and below budget.

In conclusion, Inspector General Pritchard expressed concern that repeated mistakes of the past will undermine the MTA's rebuilding effort. "Because resources will be scarce for the foreseeable future, it is imperative that the MTA and its operating agencies carefully scrutinize every project from initial survey and planning, through design, construction and final close-out of the contract.

"I agree with MTA Chairman Peter Stangl's view that capital investment in the region's mass transit system must continue because without it, the system will once again deteriorate. I also believe that if the deficiencies identified in this report are addressed, the next Capital Program will be better managed and the public's investment in making the region's public transportation system more efficient and safer will be realized."

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STATE OF NEW YORK



OFFICE OF THE INSPECTOR GENERAL
METROPOLITAN TRANSPORTATION AUTHORITY

Summary Report: Review of the
Metropolitan Transportation Authority Capital Program

MTA/IG 91-12S

October 17, 1991

JOHN S. PRITCHARD III
Inspector General

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I. INTRODUCTION

This report is a summary of "Review of the Metropolitan Transportation Authority Capital Program (MTA/IG 91-12)" by the State of New York Office of the Inspector General for the Metropolitan Transportation Authority (MTA). It presents the Inspector General's findings on the 1982-86 and 1987-91 Capital Programs, as well as recommendations for the 1992-96 program. Those involved in the discussion of the proposed 1992-96 Capital Program will find this summary a helpful source of information. The detailed report should be consulted for a more comprehensive analysis.

The MTA Capital Program was initiated to ameliorate the effects of years of inadequate capital investment in the New York metropolitan region's public transportation system. With two phases nearly completed, the Authority, in March 1991, issued a draft proposal for the 1992-96 Capital Program. Although the proposal did not have to be submitted to the State Legislature until October 1, 1991, the MTA released it earlier "to begin a public discussion of the MTA network's needs and strategic objectives for 1992-96." Our report is intended to aid that discussion by providing a detailed and objective analysis of the accomplishments and shortcomings of the first two Capital Programs.

By the late 1970s, the region's subways, buses, and commuter rail Roads (Metro-North and Long Island Rail Road) had been neglected so long they were in danger of grinding to a halt. Fires and derailments were commonplace, subway cars were breaking down at an alarming rate, and buses were dirty and unsafe. The commuter railroads depended on antiquated equipment and facilities, carried an unacceptable number of standees, and seldom ran on time. MTA management believed the continued failure to address these problems would ultimately deprive the riding public of the level of service it was entitled to.

This, then, was the climate in November 1980 when MTA Chairman Richard Ravitch called for a capital program to restore mass transit to a "state of good repair."* To achieve a state of good repair, the MTA projected that approximately \$14 billion (in 1980 dollars) would have to be spent between 1982 and 1991 to replace components of the transit system and purchase new equipment. This estimate proved to be extremely optimistic. While more than \$16 billion was spent during that period, the MTA now plans to spend \$11.5 billion** between 1992 and 1996. Of this sum, just \$6 billion is available from existing sources. Thus, the MTA must obtain additional money for the 1992-96 Capital Program.

Even if the outstanding \$5.5 billion becomes available, however, additional funds will still be needed well into the 21st century. The TA's buses, tracks, and subway cars will be in a state of good repair by 1996, but its depots, power facilities, shops, yards, stations, line equipment, line structures, and signal and communications systems will not be.

* The MTA defined "state of good repair" as eliminating all overage components and ensuring that the physical plant of the system is adequate to provide the required level of service.

** This forecast is included in the March 1991 proposed 1992-96 Capital Program. Since our report was prepared, the MTA has reduced its forecast to \$10.6 billion.

The commuter railroads are in better shape, but according to MTA documents they also have a long way to go. These documents state that Metro-North's track, cars, and signals will be in good repair by 1996, but its power system, shops and yards, stations, and line structures will not be. The LIRR's cars, tracks, and power equipment were in a state of good repair by the early 1980s, and its shops, yards and signals will reach that state in 1991. Stations will take until 1995, though, and the LIRR's line structures will not be in good repair until 2011.

These factors make it critical that the 1992-96 Capital Program be efficiently managed. In a time of increased competition for limited fiscal resources, all possible ways to improve capital project management and conserve fiscal resources must be explored.

II. ACCOMPLISHMENTS AND MAJOR PROBLEMS

During the past decade much has been accomplished to restore and enhance the subway, bus, and commuter rail systems. Thousands of new subway cars, rail cars and buses have been purchased, and those cars which are not new will have been overhauled. The system's tracks, switches and power facilities have been upgraded, and depots and maintenance shops have been restored. Clearly, our vast transit network is in much better shape now than before the Capital Program began. Despite impressive accomplishments, though, we are concerned that the MTA and its constituent agencies have fallen behind in their efforts to achieve the Capital Program's original, and still principal, goal of restoring the system to a state of good repair. We hope our review refocuses public attention on the need to attain a state of good repair and spurs discussion about whether the proposed 1992-96 program goes far enough toward meeting that goal.

NEW YORK CITY TRANSIT AUTHORITY

Management and Policy Issues

Program Erosion. When the New York State Legislature adopted the 1987-91 Capital Program in March 1987, it anticipated that \$6.7 billion in program funding would be available. The TA will actually commit just \$127 million less than that. This relatively small decrease masks major changes, though. Many of the improvements originally included in the 1987-91 TA Capital Program have been deferred, including: six of ten yard rehabilitation and expansion projects; two of four "key" station modernizations (Times Square and the Atlantic Terminal Complex); three of six depot construction projects; three of 11 depot rehabilitation projects; nine of 33 fan replacement projects; and the rehabilitation of the TA's massive 207th Street car maintenance facility.

Some of these deferrals represent changing program priorities, but increasing program costs eroded what existing funding could accomplish. Between March 1987 and December 1990 the TA deferred 193 capital projects worth \$1.7 billion while adding 207 projects worth \$1.1 billion. The \$608 million

difference between these figures includes an overall increase in the cost of 270 existing capital projects of \$481 million. This increase was not primarily due to construction contract overruns, but to an initial underestimation of project costs, and increasing design, construction administration, and post-award TA labor costs. The only program categories with consistently high construction contract cost overruns were stations and shops.

Changes in Contract Cost After Award, 1982-90
(\$ in millions)

| Category | Changes In Contracts Awarded 1982-84 | | Changes In Contracts Awarded 1985-87 | | Changes In Contracts Awarded 1988-90 | |
|----------------|--|------------|--|------------|--|------------|
| | Amount | Percent | Amount | Percent | Amount | Percent |
| Stations | \$ 7.30 | 9.8 | \$ 8.30 | 15.4 | \$ 0.74 | 4.3 |
| Track | 3.02 | 5.2 | 2.84 | 3.6 | 0.00 | 0.0 |
| Line Equipment | 2.69 | 8.8 | 5.68 | 4.9 | 1.05 | 5.4 |
| Line Structure | 5.48 | 8.9 | 4.02 | 3.8 | 3.75 | 5.9 |
| Signals | 1.26 | 2.0 | 1.34 | 1.2 | 0.89 | 6.4 |
| Power | 0.50 | 1.9 | 0.95 | 3.2 | 0.39 | 2.5 |
| Shops | 4.76 | 10.3 | 18.65 | 15.0 | 16.97 | 15.3 |
| Yards | 5.65 | 8.9 | 2.71 | 5.4 | 0.85 | 5.0 |
| Depots | -0.29 | -0.5 | -8.61 | -5.5 | -3.30 | -6.0 |
| TOTAL | \$ 30.95 | 6.6 | \$ 15.88 | 3.8 | \$ 27.94 | 8.9 |

Source: TA Engineering and Construction Department

The cost of designing capital projects increased by \$94 million -- from \$228 million to \$322 million -- between March 1987 and May 1991. During that same period, the cost of construction administration rose \$70 million, from \$416 million to \$486 million. These cost increases resulted from scope changes, which necessitate additional design work, and delays, which increase the number of work hours required to administer contracts, thus increasing construction administration costs.

In-house labor costs also rose. We compared the TA's initial labor cost estimate to the current estimated cost of TA labor at completion for 324 Engineering and Construction Department projects which were at least half finished by October 31, 1990. The estimated total labor cost overrun for these projects was \$54.2 million, about 21.8 percent of the aggregate base cost of these projects. However, we observed improvement among projects started between 1987 and 1990.

TA Labor Cost Escalation, 1982-1990
(\$ in millions)

| Program Category | 1982-85 Labor Costs | | | | | 1987-90 Labor Costs | | | | |
|------------------------|---------------------|--------------|------------|---------|-------|---------------------|--------------|------------|---------|-------|
| | No. of Projects | Est. At Base | Completion | (\$) | (%) | No. of Projects | Est. At Base | Completion | (\$) | (%) |
| Stations | 39 | \$ 11.2 | \$ 14.9 | \$ 3.8 | 33.8 | 12 | \$ 2.3 | \$ 1.7 | -\$ 0.6 | -26.7 |
| Track | 16 | 37.2 | 43.8 | 6.6 | 17.8 | 8 | 26.3 | 27.9 | 1.6 | 6.1 |
| Line Equipment | 16 | 9.4 | 11.6 | 2.2 | 23.5 | 13 | 25.9 | 28.6 | 2.6 | 10.1 |
| Line Structures | 19 | 31.2 | 34.6 | 3.4 | 10.9 | 9 | 23.3 | 26.2 | 3.0 | 12.8 |
| Signals/Communications | 15 | 28.3 | 46.1 | 17.8 | 63.0 | 5 | 4.1 | 2.6 | -1.4 | -35.3 |
| Power | 16 | 2.3 | 2.1 | -0.2 | -9.6 | 12 | 2.2 | 4.4 | 2.2 | 96.4 |
| Shops | 13 | 4.2 | 5.9 | 1.6 | 36.9 | 9 | 5.4 | 6.4 | 1.0 | 17.5 |
| Yards | 19 | 10.9 | 16.2 | 5.3 | 49.2 | 2 | 3.1 | 3.1 | -0.1 | -2.2 |
| Depots | 18 | 1.4 | 3.9 | 2.5 | 179.0 | 15 | 3.4 | 5.8 | 2.4 | 71.6 |
| Other | 37 | 11.0 | 11.2 | 0.3 | 2.5 | 31 | 5.1 | 5.4 | 0.3 | 5.7 |
| Total* | 208 | \$ 147.0 | \$ 190.3 | \$ 43.3 | 29.4 | 116 | \$ 101.2 | \$ 112.0 | \$ 10.8 | 10.8 |

* May not add due to rounding.

Source: TA Engineering and Construction Department

While TA labor cost overruns appear to be diminishing, they are still excessive in the line structures, line equipment, power, shops, and depots categories. One of the causes of these cost overruns is delays. Another cause is ineffective procedures for diverting trains while work is being performed. When a project takes longer than expected, the cost of employees engaged in such activities as flagging and operating work trains increases. In addition, internal procedures for controlling labor costs are lax. The \$17 million Lenox Avenue line structure project incurred a TA labor cost overrun of approximately \$3 million. Of this amount, \$600,000 was wrongly charged to the Capital Program due to problems with the TA's computerized timekeeping system.

Progress Toward a State of Good Repair. TA efforts to achieve a state of good repair have had mixed results. The TA has restored its buses, subway cars, and primary mainline track to a state of good repair, but its efforts elsewhere have not been as successful. In most areas the TA's timetable for achieving a state of good repair has slipped substantially.*

* The September 1991 Capital Program proposal, which reduced requested funding from \$11.5 billion to \$10.6 billion, would delay the attainment of a state of good repair even further: depots (to 2000), power (to 2007), fans (to 2007), and yards (to 2015).

Slippage in Achieving A State Of Good Repair, 1983-91

| Category | Anticipated Achievement of A State of Good Repair as of: | | | |
|----------------------------|---|---------------|------------------|---------------|
| | November 1981 | March 1988 | February 1990 | March 1991 |
| Cars | 1988 | 1990 | 1992 | 1992 |
| Buses | 1989 | 1986 | 1986 | 1986 |
| Passenger Stations | Post-1991 | Post-2006 | 2009 | 2009 |
| Track (Mainline) | 1993 | 1992 | 1991 | 1991 |
| Line Equipment | 1993* | 2001* | 2001 | 2006 |
| Line Structures (Elevated) | N/A | 2000 | 2001 | N/A |
| Signals | 2003 | 2012 | 2009 | 2012 |
| Power | 1993 | 1999 | 1999 | 1999 |
| Shops | 1988 | 1997 | 2001 | 2006 |
| Yards | 1994 | 1998 | 2012 | 2014 |
| Depots | 1993 | 1992 | 1997 | 1997 |

* All line equipment except tunnel lighting.

Source: TA 1984-93, 1987-2004, and 1992-2011 Capital Needs Assessments; proposed 1992-96 Capital Plan

Construction Delays. While there is room for improvement, we found that post-award construction delays are lessening. We attribute this trend to improved project management.

Average Construction Delays in Capital Program

| Categories | Average Delay (in Months) | | |
|------------------------|---------------------------|---------|---------|
| | 1982-84 | 1985-87 | 1988-90 |
| Stations | 25 | 20 | 1 |
| Track | ** | 3 | * |
| Line Equipment | 22 | 11 | 8 |
| Line Structures | 3 | 4 | ** |
| Signals/Communications | 11 | 10 | 2 |
| Power | 8 | 8 | 1 |
| Shops | 17 | 3 | 6 |
| Yards | 19 | 9 | 2 |
| Depots | 12 | 12 | 7 |

* Insufficient number of projects to calculate average delay

** Completed ahead of schedule

Source: TA Engineering and Construction Department

Absence of Condition Surveys. The TA's 1982-86 and 1987-91 Capital Programs were prepared without the benefit of complete and accurate information about the condition of the TA's property, facilities, and equipment. As a result, the TA had to redirect funds and change priorities during its 1982-86 and 1987-91 Capital Programs. Such program areas as track, stations, and line equipment have had funding levels raised to meet unexpected needs at the expense of shops, yards, signals, and depots projects.

The importance of surveying a capital asset's condition before devising a capital improvement strategy should have become clear to TA management during the early stages of its 1982-86 Capital Program. Management acknowledged that the TA's tracks were in poor shape and set five-year expenditures at \$365 million, enough to replace approximately 50 of its more than 700 miles of track. During 1983, though, it became apparent that the TA had underestimated how much work was needed. In June 1983, after 12 mainline derailments, the Transit Authority conducted an emergency inspection which determined that the tracks were in such poor shape in some areas that 512 emergency slow speed orders had to be posted. The TA was ultimately forced to shift more than \$225 million from other program areas to substantially accelerate track replacement and rehabilitation.

After being caught off guard by the poor condition of its tracks during the 1982-86 Capital Program, the TA should have been more alert to the importance of surveying its facilities and equipment while planning the second Capital Program. However, the TA continued to plan without adequate information about the condition of its equipment and facilities. The TA planned to spend \$45 million on stations from 1987-91, but did not undertake a comprehensive structural survey of stations before deciding how to spend the money. Thus, the TA failed to determine whether any of its stations had structural defects which should be corrected before doing primarily cosmetic work.

The effects of these omissions were first felt when serious structural defects were discovered at the Nevins Street Station in Brooklyn in 1988. The TA took interim steps to prevent further deterioration and to assure the continued safe operation of the station until its scheduled restoration in 1992.

Between the latter part of 1988 and October 1989, the TA's Stations, Engineering and Construction, and Track and Structures departments conducted the first comprehensive review of the structural condition of the TA's 469 stations. The review found 133 stations, including Nevins Street, with "apparent major structural deficiencies." Nevins Street was surveyed on April 13, 1989. The report stated that:

The present condition of this station is beyond repair. Extreme conditions of steel corrosion and concrete crumbling and falling are evidence of the degree of decay. The safety of our employees and customers is compromised seriously if a major rebuilding of the station is not undertaken immediately. It is recommended that a test of the structural integrity of this station be performed promptly.

No additional tests were performed, though, and in the summer of 1990, additional structural problems were discovered by an Engineering and Construction Department engineer. It was only then that TA management realized the magnitude and seriousness of the structural deterioration at Nevins Street. In September 1990, the MTA Board approved a \$10 million emergency contract to reconstruct the station.

In an analogous situation, the Capital Program for emergency ventilation fans was ten years old before the TA commissioned a systemwide survey of the existing ventilation system. From 1980 through 1991, the TA pursued a policy of replacing fans "as required," and doing its best to keep almost 200 antiquated fans operating. It was not until after the December 28, 1990 Clark Street tunnel fire highlighted the importance of the emergency ventilation system that TA management decided to survey the ventilation system, determine what the TA's ventilation needs are in light of current National Fire Prevention Association safety standards, and develop an overall ventilation strategy.

A related problem is that insufficient information about a system's condition makes it difficult to gauge final costs. The TA, for example, included a number of projects in its 1987-91 Capital Program which tapped into the station power supply without first determining whether it could power these additional improvements. As a result, the TA initiated the AFC program in 1984 and spent \$18 million to test AFC-style turnstiles in 1986, in the belief that the total program would cost \$80 million. When it was later discovered that the existing power supply was inadequate, the need to upgrade station power added \$200 million to the cost of the program.

Design Phase Shortcomings. In 1986 the TA Engineering and Construction Department approved nearly \$30 million in additional work orders. In 1986 and 1987 that figure dropped to \$10 million and \$11 million, respectively. While 1988 figures are not available, we found that in 1989 and 1990 the cost of additional work orders for Engineering and Construction Department projects rose again to \$24.5 million and \$18.4 million, respectively. During the first five months of 1991, \$5.2 million in additional work was approved. Thus, we fail to see a significant long-term downward trend in the cost of additional work orders.

Cost of Engineering and Construction Department Additional Work Orders, January 1989 - May 1991
(\$ in millions)

| Year | Basis Conditions | | Change/Corrections | | Errors/Omissions | | Total | |
|-------------|------------------|---------|--------------------|---------|------------------|---------|---------|---------|
| | Amount | Percent | Amount | Percent | Amount | Percent | Amount | Percent |
| 1989 | \$ 14.6 | 67.7 | \$ 6.1 | 24.8 | \$ 1.8 | 7.5 | \$ 24.5 | 100.0 |
| 1990 | 10.7 | 90.8 | 0.7 | 1.0 | 1.5 | 8.2 | 16.4 | 100.0 |
| 1991 (5 mo) | 2.4 | 66.7 | 1.2 | 33.3 | 0.9 | 22.4 | 2.6 | 100.0 |
| Total | \$ 27.7 | 76.4 | \$ 8.0 | 24.2 | \$ 4.2 | 12.8 | \$ 40.0 | 100.0 |

Source: TA Engineering and Construction Department

From January 1989 through May 1991, approximately 9 percent of additional work order charges incurred by the Engineering and Construction Department were due to design errors and omissions. Several of the projects we reviewed incurred significant additional costs due to design errors and omissions.

- As of March 1991, the Jamaica Maintenance Shop had \$4.8 million in approved additional work order costs. More than 12 percent of this cost, \$571,000, appears to have been caused by design errors. One particularly costly additional work order (\$337,000), which probably could have been avoided, was due to poorly placed utility lines in the work pits. As designed, these air, water, and electrical lines would have interfered with maintenance crews working on the trains.
- Because the new Flushing Depot was built on soft ground, it had to be built on piles to prevent excessive settling. The design consultant failed to take adequate measures to prevent utilities, such as fuel tanks and the Brooklyn Union Gas Company connections, from settling. As a result, some utility lines ruptured. The final cost of this mistake will be about \$1.2 million.

When additional construction costs are incurred because of design errors, the TA should "backcharge" design consultants who are at fault. In the past, the TA has not always done so. The TA's reluctance to hold its consultants accountable for their mistakes stems from its belief that this would create a confrontational climate that might drive away viable firms.

During the current review we determined that neither the Engineering and Construction Department, nor the Contracts Department monitors backcharges. The TA has also recently increased the threshold at which an errors and omissions study must be performed from \$15,000 to \$50,000. Such studies determine whether a backcharge is appropriate. That change, coupled with the Engineering and Construction Department's failure to monitor backcharges, is a further indication of the TA's unwillingness to hold its consultants accountable for inadequate work.

The most common reason for additional work orders was unforeseen site conditions. Such work can, in many instances, be avoided by performing a more comprehensive site survey during project design. Adequate field surveys have not always been routinely performed during project design and in many cases, especially with equipment contracts, surveys were simply not conducted.

Analysis of Capital Program Categories

Rolling Stock. The new subway car and car overhaul programs have been the TA Capital Program's most visible successes. Program costs have been kept in line and Mean Distance Between Failures (MDBF) -- the TA's principal indicator of fleet reliability -- jumped from 6,700 miles in 1981 to over 30,000 miles in 1990. The TA expects its subway car fleet to achieve a state of good repair in early 1992.

The Bus Procurement Program has also been a success. The TA spent more than \$400 million on 2,469 new buses between 1982 and 1990. During that

period, MIBF increased from 876 miles to 2,553 miles. Almost 90 percent of the fleet is air conditioned and almost 80 percent is now accessible to elderly and handicapped riders.

Stations. The Capital Program for stations has been one of the most clear-cut failures of the two Capital Programs. Though planned 1987-91 station commitments rose from \$458 million to \$727 million between March 1987 and April 1991, the TA has not demonstrated its ability to substantially improve station conditions in a reasonable period of time at a reasonable cost.

The Station Modernization Program has been beset by cost overruns and delays since its inception and, as a result, the TA has achieved much less than anticipated at much greater per-unit cost. In 1982, the TA expected to modernize 50 stations for \$227 million between 1982 and 1986. It now expects to modernize just 23 stations for \$220 million by the end of 1991.

Extensive construction delays have left many stations in disrepair for extended periods, inconveniencing tens of thousands of riders. When we reviewed the Station Modernization Program in 1989, 21 stations were completed or in progress. These jobs were, on average, 29 months behind schedule due to the TA's inability to manage its contractors effectively, poor consultant performance, poor planning and design, incomplete site surveys, and unrealistic work schedules. Six of these 21 stations have incurred additional delays of 8 to 13 months since then. Grand Central Station experienced the longest delay, 13 months.

In addition, completed station modernizations show signs of premature deterioration. Water damage is apparent at the Newkirk Avenue, 23rd Street (Lexington Avenue), 53rd Street, and Astor Place stations. We observed missing, cracked, and/or patched up sections of floor and wall tiles at the Borough Hall, Grand Central, 23rd Street, and Newkirk Avenue stations. The appearance of these problems so soon after modernization has been completed calls into question the quality of the work performed.

TA management initiated the Station Restoration Program in 1987. Its goal was to use TA laborers to return stations to a state of good repair more quickly and cheaply than under Station Modernization. Like the Station Modernization Program, though, the TA began construction without adequate planning and encountered unexpected problems, such as water infiltration and greater than expected structural deterioration. The result was cost escalation and delays. The first 30 restorations were expected to cost \$31 million. In 1989, the estimate had risen to \$54 million.

While the Station Restoration Program was not as fast or inexpensive as the TA believed it would be, we reported in September 1989 that it had the potential to remedy the poor condition of many stations faster and cheaper than station modernization. O'Brien-Kreitzberg, the MTA's independent engineers, found the quality of work to be excellent. However, O'Brien-Kreitzberg recommended restructuring the program with Engineering and Construction taking the lead role because the program was fragmented and poorly coordinated. The TA adopted this approach, renamed the program the Station Rehabilitation Program, and assigned approximately half the work to contractors.

While it is too early to assess the effectiveness of the Station Rehabilitation Program as it is currently configured, problems have already begun to develop. As of May 1991, both the Track and Structures and Engineering and Construction departments staff assigned to the Station Rehabilitation Program were inadequate for the amount of work envisioned.

The Program Planning and Development Unit had just two staff members and the Station Design Unit had a full-time staff of 42, approximately one-half the number of people O'Brien-Kreitzberg considered necessary. While Track and Structures was expected to do half the Station Rehabilitations, about ten stations a year, it has sufficient staff to complete only four stations annually.

The Deputy Vice President in charge of the Station Rehabilitation Program told us that the TA was waiting to see how much money would be available for the 1992-96 program before hiring additional workers. He said that projects deleted from the in-house program would be performed by contractors if capital funding is available. If funding is not available, these projects will be eliminated from the 1992-96 program. As a result of these problems, the number of stations that will reach a state of good repair by 1996 may be significantly fewer than the 118 stations the TA expected to rehabilitate.

Automated Fare Collection. By the end of the third Capital Program, the TA will have spent over \$700 million on automated fare collection (AFC) and associated improvements. It has justified this expenditure by asserting that AFC will increase revenue by \$66 million to \$106 million per year in three ways: (1) \$41 million from reduced fare evasion; (2) \$10 million to \$50 million from flexible pricing; and (3) \$15 million from greater convenience. There is, however, little empirical support for this.

To determine whether AFC would reduce fare evasion and increase paid ridership, the TA computed daily fare evasion and ridership at one of the 18th Street IRT station's fare control areas during a one-month-long period before the installation of three AFC turnstiles and floor-to-ceiling railings and gates. Fare evasion dropped and the number of paying passengers increased substantially during a second one-month-long period following the installation of these fixtures. The TA then extrapolated its results, which included fewer than 10,000 riders and 800 fare evaders at one station during a two-month period, to the remaining 468 stations. Based on this analysis, the TA projected a \$41 million revenue increase. However, much of the reduction was due to the newly installed railings and gates, rather than AFC. In addition, it is inappropriate to extrapolate results at just one station to the entire system.

The TA's assertion that flexible pricing and improved marketing opportunities (i.e., reduced off-peak fares) will increase subway revenue by \$10 million to \$50 million annually also lacks empirical support. To determine the impact of reduced off-peak fares, the TA applied studies of previous fare increases on total ridership. However, a February 28, 1990 TA assessment of that methodology concluded that "the elasticities are assumed the same for increasing and decreasing fares. This is probably not true ... [I]n-house research on peak and off-peak elasticity, based on hourly ridership counts provided inconclusive and counter-intuitive results More information needs to be acquired for more precise ridership and revenue estimates."

Finally, the TA stated that AFC will be more convenient than the current system and that this will result in an annual revenue increase of \$15 million. This figure is taken from an illustrative example contained in briefing materials prepared for the MTA Board. It is not based on study at all. Nevertheless, it has been incorporated into the TA's AFC benefit-cost analysis.

Track. The Capital Program for track has met or exceeded its goals in most areas. The TA's 645 miles of primary mainline track reached a state of good repair in January 1991. TA management believes the Authority's mainline switches will reach a state of good repair in 1997. This is a realistic goal if funding is available. Yard switches will not reach a state of good repair in the foreseeable future.

Line Equipment. The TA's line equipment is further from being in a state of good repair than any other system except signals. When the Capital Program started in 1982, more than 75 percent of the TA's tunnel lights, pumps, and fans were more than 40 years old. TA management does not expect these systems to reach a state of good repair until early in the 21st century.

While the TA has had some success in restoring its pumping equipment to a state of good repair, its tunnel lighting and ventilation fan programs are behind schedule. In addition, both programs have experienced delays due to design problems and cost escalation because of unrealistic initial estimates of construction, TA labor, and construction administration costs. Overall, planned 1987-91 commitments for line equipment jumped from \$35 million in March 1987 to \$449 million in April 1991. The Lexington Avenue Line contract is responsible for more than one-third of this \$414 million increase in planned commitments.

Bringing tunnel lighting to a state of good repair has been slower and more costly than envisioned. The TA planned to replace 30 route miles of tunnel lighting during the 1982-86 Capital Program for approximately \$25 million. Just seven miles were replaced for \$12.1 million. On average, each route mile of replacement lighting cost twice as much as expected.

During the second Capital Program the TA had similar problems. As of December 1990, the TA expected to award contracts to replace 35 route miles of tunnel lighting between 1987 and 1991. However, from 1987 to 1990 the TA committed funds to replace only 11 route miles of lighting. To achieve its 1987-91 target the TA will now have to commit funds to replace 24 miles of tunnel lighting in 1991, more than twice the amount done during the preceding four years. It will also have to pay at least \$66.4 million more than expected.

In addition, O'Brien-Kreitzberg believes that the incandescent lighting fixtures the TA plans to use on future lighting replacement projects, and which it has used on lighting replacement projects to date, are an obsolete form of lighting and inappropriate as a replacement for the existing tunnel lighting. Moreover, due to the current decline in use of mercury vapor, long-term availability for replacement bulbs could be an issue. Finally, the TA has not conducted tests to determine what an optimal level of lighting is, and O'Brien-Kreitzberg believes the envisioned design may be too bright.

The TA has also had problems restoring its 199 fan plants to a state of good repair. When the first Capital Program began, just four fan plants were in good shape. The September 1981 Capital Plan called for the repair or replacement of 25 plants between 1982 and 1986, but just eight fan plants were replaced during that period. The March 1987 plan included the rehabilitation of 33 fan chambers between 1987 and 1991, but just five of these fan plants -- those being replaced as part of the Lexington Avenue Line Project -- will actually be operational by the end of 1991. The TA expects to award five contracts to replace 19 additional fan plants during the last quarter of 1991. These fans will actually not be operational until 1993 or 1994.

Signals. During the first two Capital Programs, \$634 million was committed for signal modernization. The TA replaced signal equipment and enclosures over 136 track miles, or 18 percent of the 740-mile signal system. Despite these accomplishments, the TA spent less money on signal modernization than intended. The TA deferred five signal modernization projects to use the funds on higher priority non-signal projects whose cost exceeded original estimates. By deferring signal modernization projects to future periods, the TA slowed the modernization of its antiquated signals. This will delay the attainment of a state of good repair until at least the year 2012, eleven years later than originally anticipated.

As of April 1991, 327 track miles of signals, 44 percent of the entire 740 mile signal system, was in a state of good repair. To reach a state of good repair for the remaining 488 track miles by 2012, the current target, the TA will have to modernize 25 track miles of signal equipment per year. This may be overly optimistic. During the first two Capital Programs, the TA managed to modernize the signals for only 136 track miles, or 13.6 miles annually.

Shops. The subway car fleet is maintained at 13 barns throughout the system and overhaul shops at 207th Street (Manhattan) and Coney Island (Brooklyn). In addition, the TA has 18 speciality shops which fabricate or repair structural elements, track, switches, signals, and other equipment. Most of these shops and barns were in disrepair at the inception of the 1982-86 Capital Program. It was originally believed that all shops and barns would reach a state of good repair by 1986. As a result of delays, cost overruns, and deferrals the majority of TA shops and barns will not reach a state of good repair until after the proposed third Capital Program is over.

The 1982-86 Capital Program envisioned the complete modernization of both overhaul shops, all 13 barns, and a number of maintenance-of-way facilities. However, between 1982 and 1986, planned commitments for shops dropped from \$432 million to \$327.6 million. Over half of the money actually spent was used to rehabilitate the Coney Island Shop and Barn, which increased from an estimated \$126 million in 1983 to a final cost of \$192 million. Much of the other work planned for the 1982-86 program was deferred.

The 1987-91 Capital Program contained almost \$328 million to rehabilitate the 207th Street Overhaul Shop and three maintenance shops and to construct or rehabilitate 11 Track and Structures Department facilities. By December 1990, planned commitments had dropped by \$61 million to \$267 million. This decline was primarily attributable to the deferral of most of the work planned for 207th Street and several Track and Structures shops.

As a result of these deferrals, most of the TA's shops have not achieved a state of good repair. By 1992, the Coney Island Overhaul Shop and four of 15 maintenance shops will have achieved a state of good repair. Not one of the six electrical shops was rehabilitated during the first two Capital Programs and five of 12 Track and Structures Shops are not in a state of good repair.

Yards. With few exceptions, the TA has made just minimal investments in its 22 train yards. Funds were allocated to rehabilitate these yards during the first two Capital Programs, but much of the money was diverted to other areas. During the 1982-86 program just two yards -- Westchester and Linden -- underwent major rehabilitations. The 1987-91 program originally envisioned expanding or rehabilitating ten yards, but six of these projects were dropped from the program as planned expenditures dropped from \$321 million to \$111 million.

The TA expects its yard track to reach a state of good repair in 2006, its yard switches in 2012, and its yard signals in 2009. However, these estimates are questionable. The TA plans to rehabilitate two miles of track and 30 switches each year from 1992 to 1996. At that rate, the track in the yards will reach a state of good repair in 2024, and the switches will reach that status in 2018.

Depots. Depots is one of the TA Capital Program's most volatile categories. The TA failed to achieve its objectives during each of the two Capital Programs and expects to complete a program originally scheduled to take ten years in 15 years. Our review of the proposed 1992-96 program indicates that even this schedule is questionable. Moreover, the total anticipated cost of the depot program has risen from approximately \$440 million in 1982 to \$1.3 billion today.

The 1982-86 Capital Program saw the start of just two of six planned construction projects and six of 11 planned rehabilitation projects. The TA failed to achieve its goals largely because the initial planning was so poor that the entire program had to be revamped in 1985 and again in 1986. During the 1987-91 Capital Program other problems surfaced. The Hudson Pier Depot, for example, was to be replaced as part of the Westway Project. That project was delayed when Westway was eliminated from New York City's Capital Plan and further delayed by the TA's inability to find an alternate site. Constructing the Manhattanville Depot was delayed when the MTA tried to coordinate building the depot with local housing development.

The 1987 Capital Plan contained \$391.5 million for four new bus depots (Hudson Pier/West Side, Kingsbridge, Flushing, and Manhattanville) and two new central repair shops. By 1991, it was clear that just three of the six facilities the TA planned to build in 1987 -- the Flushing, Manhattanville, and Kingsbridge depots -- would be built during the second Capital Program. A new West Side Depot and two planned maintenance shops were deferred. In addition, costs increased substantially. In 1988, the cost of the Flushing Depot increased from \$25.4 million to \$66.3 million, and the Manhattanville project increased from \$87.8 million to \$104.4 million. These increases were typical of new depot projects begun during the second Capital Program and generally represent poor initial cost estimates.

The depot rehabilitation program experienced many of the same problems. Between 1987 and 1991, planned commitments for depot rehabilitation dropped from \$128.1 million to \$106.4 million due to the elimination of the Fresh Pond,

54th Street, and Jamaica depots from the 1987-91 Capital Program. However, the cost of those depots remaining in the program generally increased due to low initial cost estimates, the need to modify designs to meet operational and regulatory requirements, additional work related to design problems, and increased construction administration costs due to construction delays.

METRO-NORTH COMMUTER RAILROAD

The MTA's 1980 assessment of the Metro-North system found much of its physical plant and rolling stock to be overaged and badly deteriorated from a lack of basic maintenance over many years. Its antiquated shops, some built in the early 1900s, hampered car maintenance and many of its locomotives were old and unreliable. Switch and signal failures, and an obsolete power supply, contributed to train delays. The railroad's bridges, tunnels, and viaducts required repairs, rehabilitation, or replacement. While station conditions varied greatly, a 1983 survey found that many were inadequate.

Metro-North planned to spend almost \$1.7 billion between 1982 and 1991 to rebuild its physical plant and thus accommodate increased ridership. While nearly equal amounts were spent in each of the two five-year Capital Programs, Metro-North shifted its focus in the 1987-91 Capital Program. In the \$803 million 1982-86 Capital Program, Metro-North focused on bringing much of its car fleet, line structures, signals, tracks, and power system to a state of good repair. The \$807 million 1987-91 Capital Program continued Metro-North's efforts to rehabilitate its system, but emphasis changed from rolling stock and power to stations and line structures.

With just a few exceptions, Metro-North completed its projects on schedule and within budget. Some projects were deferred, though, and a few experienced delays, cost overruns, or both. Causes included faulty engineering surveys and designs, changes in scope due to unforeseen site conditions, and outside factors, such as government agencies and community groups. Its overall performance, however, was good.

Rolling Stock. Although Metro-North's purchase of new cars and locomotives during the 1982-91 period has been relatively trouble-free, the dual-mode locomotive project experienced major problems. Due in part to the small number of bidders for the job, the contract was awarded a year late. Since then, delays have increased. Five prototype locomotives were supposed to be completed by June 1990, but they are not expected until October 1991, 16 months late. O'Brien-Kreitzberg attributes these delays to inadequate designs and poor management and supervision.

Stations. Metro-North generally met its goals for passenger stations, but several projects were deferred or delayed. The railroad deferred the \$73 million Grand Central Terminal North End Access project because of problems coordinating financing with other government agencies and private businesses. Negotiations, however, are continuing.

Metro-North's plan to build a new Yankee Stadium Station were postponed because a long-term lease was not completed between the Yankees and the City of New York.

Because of legal and political problems with municipalities over their share of matching funds, Metro-North expanded parking at only seven of the 14 locations where it had originally hoped to complete parking projects. Metro-North put off the planned purchase of ticket vending machines until a fare collection study is completed.

Line Structures. Line structure improvements have generally been completed as planned. However, there have been several exceptions.

The Park Avenue Tunnel, Metro-North's largest single line structure project, was delayed 10 months when the discovery of wood pilings led to a change in the design of the tunnel's concrete roof. Also contributing to the delay were defective concrete ties which Metro-North had to replace.

Metro-North experienced a nine-month delay in its program to upgrade its interlockings because the type of equipment was changed, triggering problems with the "Buy America" law. Reconfiguring the Mott Haven Interlocking cost \$5 million more than planned because more work was required than expected. Waiting for the Urban Mass Transportation Administration (UMTA) to approve additional federal funds might delay the project as long as a year.

Rehabilitating the New Hamburg Bridge was put on hold when the U.S. Coast Guard declared that the waterway required a drawbridge rather than a non-movable bridge. Future work is now dependent on the passage of a bill in Congress.

Repairing the railroad's bridges will cost considerably more than anticipated due to unexpectedly severe deterioration. This led to extensive design changes and concomitant delays. Inadequate surveys of bridge conditions led to this problem.

Signals and Communications. Metro-North's signals and communications projects were, or will be, completed on time and within budget, with two exceptions. First, the cost of the Grand Central Terminal Signals, Interlock, and Track Project rose from \$31.2 million to \$40.6 million. Of the total \$9.4 million increase, \$7 million was to upgrade the terminal's switches. Increases in force account, spare parts, and engineering work made up the balance. Second, a project to install car signaling from Mott Haven to 57th Street may be delayed up to one year due to problems completing track work in the area. Consequently, the signal and track work could not be coordinated as planned.

Power. The New Haven Line catenary project experienced a one-year delay and significant budget increase. The budget rose from \$35.1 million to \$47.3 million after design was completed due to revised construction and staging plans, increased labor and material requirements, and the addition of structural work to the project's scope. The delay was due to the time it took to approve additional funds. As a result of the delay, Metro-North put off replacing four Anchor Bridge substations on the New Haven Line until the 1992-93 Capital Program.

Shops and Yards. Metro-North completed most of its shop and yard projects on schedule and within budget. New York State Department of Environmental Conservation's (DEC) involvement with the railroad's shops and yards projects contributed to some delay when Metro-North redesigned project scopes to meet environmental requirements or delayed construction until DEC

approved project designs. Delays have also been caused by other government agencies besides DEC. This problem affected not only Metro-North but the LIRR and TA as well.

LONG ISLAND RAIL ROAD

Prior to 1981, the Long Island Rail Road (LIRR) faced serious problems due to an insufficient car fleet, antiquated shop facilities, inadequate lay-up yards, and outmoded or overaged track equipment including interlockings, signals, and switches. In addition, many of its passenger stations needed upgrading, and platforms needed to be either extended or totally replaced.

These inadequacies in its physical plant led to significant operational deficiencies. For example, while thousands of commuters had to stand during rush hour because the railroad had too few cars, its maintenance facilities, some constructed prior to 1900, were too small and antiquated to handle even the existing fleet and diesel coaches had to be serviced outdoors. Overaged track equipment such as interlockings and signals also caused congestion and delays.

The LIRR's capital priorities have shifted significantly between the two five-year plans. The \$1.1 billion 1982-86 Capital Program focused on building the Hillside Maintenance Complex, purchasing 170 new electric cars, constructing a new train storage yard near Penn Station, and electrifying sections of its Main Line and Port Jefferson Branch. The LIRR concentrated its \$1 billion 1987-91 Capital Program on rebuilding its passenger stations, especially Penn Station, line structures, signals and communications equipment, and track.

Although the LIRR has completed a number of important projects since 1987, its second Capital Program has experienced frequent funding shifts and changing priorities. Such shifts appear to be due, in part, to inadequate project scope and cost estimates, a lack of site condition surveys, repeated changes in top management, and new federal and state mandates related to the environment and to access for the elderly and disabled. Frequently, however, these changes occurred when management decided to eliminate some projects to cover cost overruns on other projects.

Our review of the LIRR's Capital Program found that a substantial number of projects were deferred, delayed, or required significant budget increases. Many of these deferrals were due to rising costs of the Hillside Maintenance Complex. Because of the effect it had on other projects, the federal government held up funding until the LIRR could demonstrate that it had addressed serious management weaknesses. Our major observations of each of the Capital Program categories follow.

Rolling Stock. Testing the LIRR's new technology cars and locomotives has been delayed and these prototypes will cost much more than expected. Three prototype dual-mode locomotives are 16 months late and will cost more than twice the original estimate. Testing ten new bi-level cars was delayed six months because of the delay in the manufacture of the dual-mode locomotives. This project's budget has also almost doubled from its original estimate.

Stations. Most goals for LIRR stations were met, but one project was substantially increased and several others were scaled back or dropped. From 1986 to 1990, the LIRR continually revised the scope of Penn Station

improvements, increasing the project budget from \$40 million to \$198 million (110 percent). The LIRR deferred a \$4.3 million refurbishment of the aging Flatbush Avenue Terminal and \$7.5 in repairs to the Hunterspoint Avenue Station in response to uncertainty about development activities by the City and MTA and the need for additional funding for Hillside.

Track. The LIRR met or exceeded most of its goals for its annual track rehabilitation programs from 1987 through 1990.

Line Structures. The LIRR deferred or substantially reduced the scope of several line structures projects. Of the \$312 million originally budgeted, only \$145 million was expected to be committed by the end of 1991. Modernizing the Jamaica Complex, including its track, signal system and interlockings, was substantially scaled back. More than \$200 million budgeted for this project was transferred to other needs.

From 1987 to 1990, estimates for repairing the Atlantic Avenue Viaduct have risen tenfold, from \$14 million to \$140 million. The project has been delayed several years as the LIRR sought three consultants' opinions on the viaduct's condition. Replacing a railroad bridge in Reynolds Channel cost twice what the LIRR first estimated because it could not be built at the planned location.

Signals and Communications. Most of the increase in the signals and communications budget stems from an increase in one major project which was partially offset by a canceled project. The reverse signaling project from Jamaica to Penn Station included work on the Harold Interlocking which rose by over \$3 million to complete the work faster than originally planned. The LIRR canceled the \$20 million Jamaica to Valley Stream reverse signaling project when it reduced the scope of the Jamaica Complex project and decided the signal project had little benefit.

Shops and Yards. Most of the 1987-91 shops and yards budget was spent on finishing work at Hillside. The LIRR also dropped two projects totalling \$29 million to offset overruns in other projects.

Electrification. The LIRR changed its strategy on extending electrified track and cut its \$130 million electrification budget in half. Most of the cut came from scaling back the Main Line Third Track project. Included in this category is a \$48 million LIRR contribution to a New York State Department of Transportation project to eliminate six unsafe grade crossings in Mineola.

III. RECOMMENDATIONS

1. Policy-makers, including the MTA Board, Capital Program Review Board, and the Legislature, should assess whether the TA's schedule for achieving a state of good repair, especially for such critical infrastructure and equipment as tunnel fans and pumps, signals, and yard tracks, is appropriate given the Capital Program's principal goal of preventing a recurrence of the deterioration that characterized the system in the 1970s.
2. The TA should improve its process for preparing budgets and cost estimates to avoid underestimation, project deferrals, and large cost increases over the life of many capital projects.

3. The TA should take steps to better track and control in-house labor costs. It should determine whether operating expenses were incorrectly charged to the Capital Program on any projects besides the one mentioned in this report. In addition, a procedure should be devised whereby the Rapid Transit Operations Department notifies the Engineering and Construction Department of the estimated cost of service diversions before such diversions actually take place.
4. The TA should act to better control construction administration and design cost increases resulting from prolonged project delays and other causes.
 - a. MTA agencies should use sound cost/benefit methodologies and empirical data to justify proposed projects furthering purposes other than restoring the system to a state of good repair.
 - b. MTA staff should carefully review all cost/benefit analyses to ensure they are both rigorous and well-documented with reliable data.
5. The TA must determine how much light is needed in its tunnels and design a system to provide such light. In preparing the design, management should take into account the effects of glare on train operators. Alternatives to mercury vapor lighting should be assessed.
6. The TA's Engineering and Construction Department should ensure that complete and accurate surveys of the condition of capital assets are undertaken during project planning and design.
7. The LIRR should seek advice from MTA and industry experts when planning major rehabilitation projects, such as viaduct repair, for the first time.
8. The TA should seek ways to reduce the number and cost of additional work orders caused by design errors and omissions. Similarly, more thorough design surveys should be undertaken to minimize additional work orders caused by unforeseen site conditions.
9. The TA should aggressively pursue recouping any extra costs incurred due to design errors and omissions.
10. The TA should establish an accurate and comprehensive database of additional work orders which should be backcharged to design consultants because of design errors and omissions. It should also monitor funds recovered as a result of backcharging.
11. MTA and LIRR Capital Program staff should monitor the budget and priority-setting process to prevent any recurrence of the 1989 problems which led LMTA to hold up federal funding of the Capital Program.
12. The MTA and its constituent agencies should explore ways to minimize delays caused by outside agencies. Such efforts could include additional community outreach, advance planning with state environmental officials, and stronger commitments from funding partners.

IV. CONCLUSION

By the end of 1991, the MTA will have allocated over \$10 billion to restore and improve its deteriorated transit system. In May 1991, though, TA officials cautioned that after spending \$12.5 billion on subway cars, buses, and track repairs, the job is not quite half done. The TA's stations, signals, water pumps, ventilation fans, tunnel lighting, power substations, depots, yards, shops, and infrastructure still need substantial work. Even if the MTA receives the funds it seeks for its proposed 1992-96 Capital Program, some major system components will not be in a state of good repair until the second decade of the 21st century.

The TA, especially, has not met its schedule to bring stations, shops, yards, and such infrastructure items as line equipment and signals to a state of good repair. According to the TA's own projections, stations will take until 2009, 16 years later than the goal set in late 1983. Similarly, shops will take until 2006, 18 years later; yards will achieve good repair in 2015, 21 years later; for line equipment (tunnel fans, pumps and lights) the date is 2007 instead of 1993; for signals it is 2012 rather than 2003. Bridges and viaducts for the commuter railroads will take until 2011, and Metro-North's stations and shops and yards will not reach a state of good repair until 2005.

Obtaining the necessary funds to continue to restore the system is likely to be more difficult than in the past. First, money is scarce. The city, state and federal government are in the midst of a recession. New York State and New York City have both had to severely cut their budgets, and after several years of growth, MTA ridership has begun to decline, a trend primarily attributed to the weak economy in the New York region.

In addition, before the Capital Program began riders could easily see the deterioration in the condition of the aging subway and bus fleets, and in the numerous derailments, fires and other dangerous incidents. After a decade of spending, though, the needs are not so obvious. As the TA itself recently acknowledged, the "subway's aging line equipment (like tunnel lighting, signals, fan plants, and water pumps) gets attention only when it fails during an emergency." This does not, however, negate the overriding fact that without a continued infusion of capital dollars the system will soon revert to its former state.

Restoring aging structures and equipment is not the only legitimate aim of the MTA's Capital Program. Enhancing safety and security and providing a more pleasant environment are also important objectives. In addition, the MTA must seek ways to increase ridership and curb fare evasion. However, we are concerned that repeating past mistakes will limit the MTA's ability to carry out the main objective of its capital rebuilding effort. Neither the TA's 1982-86 nor the 1987-91 Capital Program was based on complete and accurate information about the condition of the TA's facilities and equipment. Consequently, such program areas as track, stations and line equipment have had their funding increased to meet unexpected needs at the expense of shops, yards, signals and depots projects. As a result, facilities and equipment in these categories will reach a state of good repair later than expected.

While problems facing the Capital Program, such as delays in funding or requirements imposed by other government agencies, are not within the direct control of management, checking the condition of physical assets before setting priorities and planning specific projects surely is. A failure to do so not only jeopardizes the success of the program, but can jeopardize the reliability and safety of subway, bus, and commuter rail operations as well.

Another serious problem is that the TA has consistently underestimated capital program costs. As a result, many of the projects included in the 1987-91 Capital Program were eventually deferred because available funding was eaten up by cost escalation in construction projects already underway. This is one of the primary reasons the TA has fallen further behind in its efforts to achieve a state of good repair.

We also believe the MTA must do a better job of calculating the benefits its new initiatives will produce and the costs to achieve them. Our review of the cost-benefit analysis for the planned AFC system, for example, shows that inadequate assessments can result in policy-makers making decisions based on faulty or incomplete information.

And capital projects need to be better managed. While project management has improved over the past ten years, we still found examples of inadequate planning and design which led to cost increases and delays. Keeping projects on schedule, it should be noted, will help avoid administrative and consultant cost increases.

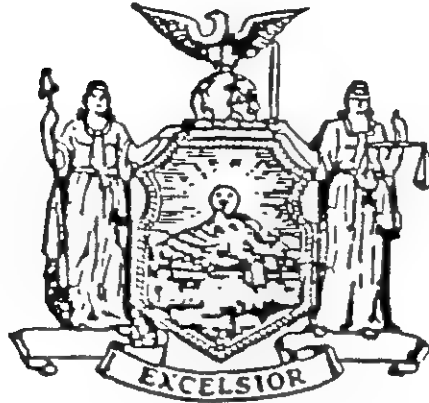
In addition, more should be done to monitor and control TA labor costs. There is no excuse for using the capital budget to absorb costs that are more appropriately funded from the operating budget. Finally, we urge the MTA and TA to adopt and enforce a policy which holds design consultants and contractors responsible for their errors.

Attaining a state of good repair is as relevant today as it was in 1980. That many of today's needs are less visible because they are underground or behind walls or ceilings does not make them any less essential. Amid competing priorities and severe budget restraints, decision-makers must judge the adequacy of the MTA's plans to bring its entire transit system to a state of good repair.

Although the MTA's Capital Programs have produced major accomplishments, there is still much work to be done and problems to be addressed. We believe that by implementing the recommendations in this report, the work done under the next Capital Program will be better managed and the public's investment in rebuilding our public transportation system will be better protected.

The detailed report on which this summary is based is available for review at the Office of the Inspector General, 100 Park Avenue, 14th Floor, New York City

STATE OF NEW YORK



OFFICE OF THE INSPECTOR GENERAL
METROPOLITAN TRANSPORTATION AUTHORITY

Review Of The
Metropolitan Transportation Authority
Capital Program

MTA/IG 91-12

October 17, 1991

JOHN S. PRITCHARD III
Inspector General

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SECTION ONE: INTRODUCTION

By 1980, the Metropolitan Transportation Authority (MTA) region's subways, commuter railroads, and buses had been neglected for so long they were in danger of grinding to a halt. Subway fires and derailments were commonplace, subway cars were breaking down at an alarming rate, and buses were dirty and unsafe. The commuter railroads had serious equipment problems, carried large numbers of standees because of inadequate capacity and seldom ran on time.

Most of these problems stemmed from inadequate capital investment in transportation infrastructure and equipment. Between 1972 and 1981 little was spent on capital revitalization, and in 1980, the MTA characterized its transportation network as "deteriorating at an accelerating rate." The MTA also predicted that failure to increase capital spending would lead to higher maintenance costs and significantly diminish the quality of service the MTA provided the riding public.

Origin of the MTA Capital Program

This, then, was the climate in November 1980 when MTA Chairman Richard Ravitch called for a capital program for the metropolitan area's transportation system to restore mass transit to a "state of good repair."* The goal of the proposed program was to provide the public with the quality of service it desired and to which it was entitled. To achieve a state of good repair, the MTA projected that approximately \$14 billion (in 1980 dollars) would have to be spent between 1982 and 1991 to replace components of the transit system and to purchase new equipment.

Existing funding sources were incapable of providing that much money. Historically, non-federal funding for the MTA's capital needs came solely from the sale of New York State and New York City general obligation bonds. This changed in 1981 when the New York State Legislature created new financing mechanisms for long-term capital improvements, streamlined the process by which capital funds were allocated, and identified long-term revenue sources.

With the passage of the Transportation Systems Assistance and Financing Act in January 1981, the State Legislature authorized the MTA to issue -- for the first time -- its own revenue bonds and other obligations which were backed by farebox revenues of the New York City subway and bus system, and the commuter railroads. The statute also extended Triborough Bridge and Tunnel Authority borrowing authority for MTA mass transit projects; authorized the State to enter into long-term service contracts for payment of debt service on MTA obligations and for other purposes; and changed New York State and New York City procedural requirements to expedite capital construction by the MTA.

The availability of funds for capital revitalization permitted the MTA to submit a \$7 billion five-year Capital Program for the New York City Transit Authority (TA), the Long Island Rail Road (LIRR), and the Metro-North Commuter Railroad (Metro-North) to the State Legislature in September 1981. That program permitted these subsidiary operating agencies to begin undertaking the capital revitalization process proposed the year before.

* The MTA defined "state of good repair" as eliminating all overage components and ensuring that the physical plant of the system is adequate to provide the required level of service.

Purpose and Scope of the Inspector General's Review

The MTA Capital Program has entered its tenth year and the Authority, in March 1991, issued a draft proposal for the 1992-96 Capital Program. This document must be submitted to the State Legislature by October 31, 1991. The MTA released the draft program well in advance of that deadline "to begin a public discussion of the MTA network's need and strategic objectives for 1992-96." The Inspector General's report on the progress of the MTA Capital Program is intended to aid that discussion by providing factual information and an objective analysis of the accomplishments and shortcomings of the first two Capital Programs.

We begin by noting that while more than \$16 billion has already been spent on capital improvements, the MTA forecasts capital needs of \$11.5 billion* between 1992 and 1996. We also note that even if this money becomes available to the MTA, additional funds will still be needed well into the 21st century to complete the program begun in 1982.

While the TA's buses, tracks, and subway cars will be in a state of good repair by 1996, its depots, line structures, power facilities, shops, yards, stations, line equipment, line structures, and signal and communications systems will not. The railroads are closer to achieving a state of good repair, but they have a long way to go. Metro-North's track, cars, and signals will be in a state of good repair by 1996, but its power system, shops and yards, stations, and line structures will not. The LIRR's cars, track, and power equipment attained a state of good repair in the early 1980's and its shops, yards and signals will reach that level in 1991. Stations will take until 1995 and the LIRR's line structures are not expected to reach a state of good repair until 2011.

Finally, we note that the MTA faces a serious funding gap for the 1992-96 Capital Program. According to the MTA, of the \$11.5 billion needed, just \$6 billion is available from existing revenue sources. Moreover, this presumes that federal, state, and New York City funding will continue at 1987-91 levels through 1996. During the 1982-86 and 1987-91 Capital Programs, the gap between capital needs and available funds was filled by bond proceeds. However, this is not feasible for the 1992-96 program. Debt service on bonds must be paid from operating revenues. The MTA has acknowledged that current operating budget projections indicate that there is no additional debt service capacity.

These factors make it critical that capital projects funded under the 1992-96 Capital Program be managed as efficiently as possible. In a time of increased competition for limited fiscal resources, all possible ways to improve capital project management and achieve savings must be explored. By identifying the causes of delays, cost overruns, and project deferrals, this review seeks to help the MTA and the Legislature avoid the pitfalls of the past and maximize the results of the proposed third Capital Program.

For each of the commuter railroads and the TA, we examined program goals at the outset of the program in 1982 and traced the many changes that took place between then and now. We examined the various estimates of when

* This forecast is included in the March 1991 proposed 1992-96 Capital Program. Since our report was prepared, the MTA has reduced its forecast to \$10.6 billion.

different types of facilities and equipment would reach a state of good repair. When it became obvious that these projections had begun to extend farther and farther into the future, we attempted to determine why.

While we considered all capital projects beginning with those commencing in 1982, our primary focus was the 1987-91 program. Using documentation provided by the MTA and each of its three major subsidiaries, we identified projects which had suffered delays or cost overruns and attempted to determine their impact in terms of how long it would take to achieve a state of good repair, and how much additional money would be needed to compensate for cost escalation.

As part of this study, we spoke to high-level Capital Program managers at all agencies, to those in charge of the various program areas (e.g., cars, stations, tracks, etc.), and to the project managers in charge of individual projects. While much of the data used in the preparation of this report came from the Capital Plans and Capital Plan Amendments prepared by MTA staff, we also examined a wealth of materials provided by the agencies themselves.

Much of the information that we relied on came from the December 1990 Proposed Capital Plan Amendment. This amendment was approved by the MTA Capital Program Review Board in April 1991 and released in late June 1991. This document was similar to the December 1990 submission. Because of this, and the difficulty of updating months of analysis to incorporate relatively minor changes, our review continues to rely on the December 1990 amendment. However, significant changes between that document and the June 1991 approved version have been noted when they affected our analysis.

Besides reviewing MTA documents and those prepared by its subsidiaries, we reviewed reports prepared by outside agencies, such as the City and State Comptrollers, and by private consultants. We also examined the many reports on and investigations of the Capital Program prepared by the Inspector General's Office. The primary reason for examining these reports was to determine during the current review whether problems identified in the past have been corrected. These reports are described briefly below and are cited in the body of this report as necessary.

In response to a draft of this report, MTA Chairman and Chief Executive Officer Peter E. Stangl called our report "a fairly accurate appraisal of the progress made by the MTA in meeting the objectives of the first two Capital Plans as well as presenting a balanced view of each agency's accomplishments and shortcomings." Responses were also received from the MTA's Capital Program Management Department and the presidents of the Transit Authority, Metro-North and the LIRR. Although the agency responses reflected general agreement with the report's findings and recommendations, a number of objections to specific points were raised.

The MTA and agency responses can be found in Appendices A-D. Appendix E contains the Inspector General's comments on major issues raised in the responses. Metro-North and the LIRR suggested updating or clarifying information in the draft report. The final report incorporates a substantial number of these suggestions.

We conducted this audit in accordance with generally accepted government auditing standards which require that we plan and conduct our review to adequately assess those activities that are included in our audit scope. Our audit also included tests of the records and other auditing procedures considered necessary.

Prior Inspector General Reports

Section 1279 of the Public Authorities Law gives the Office of the Inspector General the authority to review the operations of the MTA and its subsidiaries. The Inspector General released 16 reports on various aspects of the MTA's Capital Program between 1986 and 1991. Included were reviews of the controversial 63rd Street Tunnel, TA procedures for handling additional work orders, and the TA's station modernization program.

Our review of the 63rd Street Tunnel Project called into question the TA's ability to coordinate the activities of the many departments involved in capital construction projects. Because some public officials questioned the tunnel's structural integrity we analyzed the project's history and assessed the extent of its deterioration. We concluded that improper maintenance had created an appearance of structural problems. Although no structural problems were found, management's failure to specifically assign responsibility for maintenance allowed problems to grow and "slip through the cracks."

Our review of additional work orders examined the TA's oversight of construction contractors. While the TA had issued comprehensive procedures for handling additional work orders, we noted gaps in the required recordkeeping and processing delays. More importantly, we found that the TA had not effectively backcharged design consultants for their mistakes (errors and omissions) and consequently did not recoup any of the losses it suffered.

Our assessment of the TA's subway stations program found that this effort fell far short of its goals, was behind schedule, and was far more expensive than first planned. In 1988, the average modernization project was two and a half years behind schedule and its cost had risen by 23 percent. Most of this increase was caused by additional work needed to finish jobs and by contractor understaffing.

The Inspector General has also audited Capital Program procedures to ensure that requirements for safety, quality and accountability were being met. These included procedures used to estimate capital project costs, to monitor the audits of architectural and engineering contracts, and to conduct field inspections at job sites. Deficiencies were found in each of these areas and corrective actions were recommended. For example, our surveys found that field inspectors were not always at job sites, and required documentation was not always prepared. We urged management to tighten its enforcement of existing comprehensive guidelines.

In addition to the audits noted above, the Inspector General has conducted numerous investigations into allegations of fraud and waste within the Capital Program. As a result of these investigations, a number of cases were referred to local, state and federal law enforcement agencies for prosecution.

Organization of Report

This report contains four sections: Section One introduces the MTA Capital Program; Section Two presents the accomplishments and major problems in the Capital Programs of the Transit Authority, SIRTOA, LIRR and Metro-North; Section Three reports on issues which affect either several Capital Program categories or more than one MTA agency; Section Four presents our concluding remarks based on our review of the program.

Section Two begins with an overview of the TA's Capital Program and then looks at each program category, e.g., bus depots, maintenance shops, track. The overview focuses on how the TA has met its goal of achieving a state of good repair and how changes in contract and in-house costs have affected program schedules and budgets ("program erosion"). Similar presentations of accomplishments and major problems in the LIRR and Metro-North Capital Programs are also found in Section Two.

Section Three discusses several broad problems that have hampered the successful implementation of the Capital Program and which agency management should resolve before a third program is begun. These issues include planning and design deficiencies, sharp increases in in-house labor costs, inadequate attention to change orders, repeated and substantial changes to the LIRR's Capital Program priorities and budgets, and project delays caused by the intervention of other government agencies.

Our review of the Capital Program focused on the TA, SIRTOA, the LIRR, and Metro-North because these agencies receive all of the MTA's Capital Program funding. Prior to its inclusion in the proposed 1992-96 Program, the Triborough Bridge and Tunnel Authority (TBTA), which funds its Capital Program through toll revenues, was not part of the MTA's Capital Program. Nassau County supports the Metropolitan Suburban Bus Authority's (MSBA) relatively small Capital Program. Consequently, we did not review the TBTA and MSBA.

Our review also focused on Capital Program categories and specific projects which we have examined in previous reports. For example, our analysis of accomplishments and major problems connected with the Station Modernization Program follows up on work done by the Office of the Inspector General in 1989.* We also devote considerable attention to the causes of the TA's additional work orders, an issue first analyzed by this Office in 1988.** A 1988 report*** on the TA's emergency response capability included an examination of the status of repairing or replacing subway tunnel ventilation fans. This Capital Program review updates that information and assesses the TA's goal of achieving a state of good repair for this critical equipment.

Included in our discussion of the importance of surveying the condition of capital assets is an examination of the TA's Nevins Street Station. We investigated the record of events which finally led TA officials to take emergency action to fix this badly deteriorated and structurally unsound station at the request of an elected federal official. This special review can be found in Section Three on page 209.

* Assessment of the New York City Transit Authority's Station Modernization, Restoration and Upgrade Programs; MTA/IG 89-17; September 22, 1989.

** New York City Transit Authority's Procedures and Practices for Processing Additional Work Orders in its Capital Construction Program: A Review; MTA/IG 88-2; August 30, 1988.

*** Assessment of the New York City Transit Authority's Emergency Response Capability; MTA/IG 88-9; December 9, 1988.

We also devoted attention to the Transit Authority's Automated Fare Collection (AFC) project, a major part of its efforts to improve subway stations and reduce fare beating. This project is the TA's largest "system improvement," i.e., a capital project intended to enhance the system rather than bring it to a state of good repair. In a 1989 report* we examined existing and proposed ways to reduce fare evasion. Curbing fare abuse is one of the anticipated benefits of AFC and estimates of increased revenue are included in the TA's AFC cost/benefit figures. Our assessment of the TA's cost/benefit analysis begins on page 59 in Section Two.

Findings and Recommendations

During the past decade much has been accomplished to restore and enhance the subway, bus and commuter rail systems. Thousands of new subway cars, rail cars, and buses will have been purchased, and those cars which are not new will have been overhauled. The system's track, switches, and power facilities have been upgraded, and many depots and maintenance shops have been restored. Clearly, our vast transit network is in much better shape now than in 1981, before the Capital Program began.

We found that Metro-North's Capital Program has generally been well-managed. Few projects had significant delays or cost significantly more than budgeted. In several instances, projects were finished well ahead of schedule and/or under budget. We also observed signs of improved construction management at the TA. With just a few exceptions, the TA has been able to prevent excessive post-award construction cost increases and, in addition, there have been fewer construction delays in recent years.

Despite impressive achievements, we are nevertheless concerned about some aspects of the Capital Program. While even the best plans have to be fine-tuned, we believe that changing priorities may have diverted agencies from the Capital Program's original, and still principal, objective of achieving a state of good repair. We hope this report refocuses public attention on the need to attain a state of good repair and spurs discussion about whether the proposed 1992-96 Capital Program goes far enough to meet that goal. This is important because cost increases beyond initial estimates have reduced what could be accomplished with the money allocated thus far. Consequently, instead of achieving a state of good repair according to schedules set in the early and mid-1980s, it will now take much longer.

Not every cost increase or project deferral resulted from mismanagement. While some cost overruns resulted from design mistakes, poor planning, and delays, projects were added to the Capital Program because of new or emphasized priorities. Regardless of the cause, though, these changes eroded the original program and diminished the MTA's ability to restore its system to good repair.

Specifically, the Inspector General's 1982-91 Capital Program review found the following problems and areas of concern:

* Review of New York City Transit Authority Police Department Strategies to Reduce Subway Fare Evasion; MTA/IG 89-3; March 28, 1989.

- The TA will actually commit about \$127 million less than the amount originally planned in 1987, but this relatively small overall budget decrease masks major changes between 1987 and 1991. A large number of projects have been deferred; 193 projects worth \$1.7 billion were deferred while 207 projects worth \$1.1 billion were added. The remaining projects tended to increase in cost; a \$608 million increase in the cost of all other projects accounts for the difference between projects added and projects dropped.
- As a result, many of the improvements originally included in the 1987-91 TA program were deferred, including:
 - o six of ten yard rehabilitation and expansion projects;
 - o two of four "key" station modernizations (Times Square and the Atlantic Terminal Complex);
 - o three of six depot construction projects;
 - o three of 11 depot rehabilitation projects;
 - o the rehabilitation of the 207th Street Shop, one of the TA's two car overhaul facilities;
 - o nine of 33 fan replacement projects;
 - o four electrical substations and nine substation enclosures; and
 - o 12 miles of signal equipment modernization and 38 miles of signal enclosure modernization.
- Because of these deferrals, TA efforts to achieve a state of good repair have had mixed results. The TA has restored its buses, subway cars, and primary mainline track to a state of good repair, but its efforts elsewhere have not been as successful. In most areas, particularly stations, the TA's timetable for achieving a state of good repair has slipped substantially:
 - o The TA now expects its stations to be in good repair by 2009. In 1983 it expected them to be in that state by 1993.
 - o TA line equipment, including critical tunnel ventilation fans, is now expected to reach a state of good repair by 2006. In 1983, it expected this equipment to be in good repair by 1993. As late as February 1990, it was expected that the ventilation fans would achieve a state of good repair by 2001.
 - o The yards where trains are stored and maintained will not reach a state of good repair until 2014, 20 years after the original target date. The TA's maintenance shops will not be in good repair until 2006, 18 years after the target date set in 1983.
- TA construction administration costs increased by \$70.1 million (17 percent) during the 1987-91 period as construction delays increased the number of work hours required to administer contracts. TA design costs also increased by \$94 million (41 percent).

- There is little empirical support for TA assertions that Automated Fare Collection would boost revenue. The TA estimates that \$66 million to \$106 million in additional revenue will be generated annually by AFC. It used these figures to justify the \$420 million needed in 1992-96 to begin implementation systemwide.
- The Capital Program for the TA's stations has been one of the most clear-cut failures of the two Capital Programs. Though planned 1987-91 station commitments rose from \$458 to \$727 million between March 1987 and April 1991, the TA has not demonstrated its ability to substantially improve station conditions in a reasonable period of time at a reasonable cost.
- Besides being over budget and behind schedule, the TA's Tunnel Lighting Program may be using an obsolete design. The MTA's independent engineer, O'Brien-Kreitzberg, reported that the mercury vapor lights being installed by the TA would have been more appropriate in the 1950s.
- Despite the importance of emergency ventilation fans, the 1987-91 Capital Program succeeded in restoring just five of them to good repair. Contracts to replace 19 more fans are scheduled to be awarded during the last quarter of 1991.
- The TA's 1982-86 and 1987-91 Capital Programs were prepared without the benefit of complete and accurate information about the condition of the TA's property, facilities, and equipment. As a result, the TA had to redirect funds and alter priorities on a number of occasions. Categories such as track, stations, and line equipment have had funding levels raised to meet unexpected needs; this has delayed the repair of shops, yards, signals, and depots.
- From 1989 through May 1991, approximately 9 percent (\$4.2 million) of all TA additional work order charges were due to design errors and omissions. While this is an improvement over what we found during our 1989 audit of the Station Modernization Program, our current review found several projects which incurred significant additional costs due to design errors and omissions. These problems probably would have been caught if a thorough design review had taken place.
- The TA does not maintain accurate and comprehensive information on additional work order costs generated by designers' errors and omissions. Consequently, it is difficult to determine whether the TA has recouped the additional costs generated by these mistakes.
- Although the LIRR has completed a number of important capital projects since 1987, its second Capital Program has been marked by frequent funding shifts caused by changing priorities. Such shifts appear to be due, in part, to inadequate project scope and cost estimates, a lack of site condition surveys, repeated changes in top management, and new federal and state mandates related to the environment and to access for the elderly and disabled.
- Due to a mistake in how the consulting contracts for inspection and design were planned, the completion of a major LIRR state-of-good repair project -- infrastructure repairs to the Atlantic Avenue

Viaduct -- was delayed one and a half years, and approximately \$175,000 was spent unnecessarily. As a result, an additional \$13 million had to be diverted from other LIRR projects to pay for basic infrastructure repairs to the viaduct.

- Besides being delayed by factors such as design changes, unforeseen site conditions, and changing priorities, capital projects have also been delayed by the intervention of outside agencies, including government and other transit agencies, not-for-profit corporations, and municipalities. Often beyond the control of the MTA operating agencies, such delays have affected the TA, the LIRR, and Metro-North.

Based on these findings, we offer the following recommendations and suggestions:

1. Policy-makers, including the MTA Board, Capital Program Review Board, and the Legislature, should assess whether the TA's schedule for achieving a state of good repair, especially for such critical infrastructure and equipment as tunnel fans and pumps, signals, and yard tracks, is appropriate given the Capital Program's principal goal of preventing a recurrence of the deterioration that characterized the system in the 1970s.
2. The TA should improve its process for preparing budgets and cost estimates to avoid underestimation, project deferrals, and large cost increases over the life of many capital projects.
3. The TA should take steps to better track and control in-house labor costs. It should determine whether operating expenses were incorrectly charged to the Capital Program on any projects besides the one mentioned in this report. In addition, a procedure should be devised whereby the Rapid Transit Operations Department notifies the Engineering and Construction Department of the cost of service diversions before such diversions actually take place.
4. The TA should act to better control construction administration and design cost increases resulting from prolonged project delays and other causes.
5. (a.) MTA agencies should use sound cost/benefit methodologies and empirical data to justify proposed projects furthering purposes other than restoring the system to a state of good repair.
(b.) MTA staff should carefully review all cost/benefit analyses to ensure they are both rigorous and well-documented with reliable data.
6. The TA must determine how much light is needed in its tunnels and design a system to provide such light. In preparing the design, management should take into account the effects of glare on train operators. Alternatives to mercury vapor lighting should be assessed.
7. The TA's Engineering and Construction Department should ensure that complete and accurate surveys of the condition of capital assets are undertaken during project planning and design.

8. The LIRR should seek advice from MTA and industry experts when planning major rehabilitation projects, such as viaduct repair, for the first time.
9. The TA should seek ways to reduce the number and cost of additional work orders caused by design errors and omissions. Similarly, more thorough design surveys should be undertaken to minimize additional work orders caused by unforeseen site conditions.
10. The TA should aggressively pursue recouping any extra costs incurred due to design errors and omissions.
11. The TA should establish an accurate and comprehensive database of additional work orders which should be backcharged to design consultants because of design errors and omissions. It should also track funds recovered.
12. MTA and LIRR Capital Program staff should monitor the budget and priority-setting process to prevent any recurrence of the 1989 problems which led UMTA to hold up federal funding of the Capital Program.
13. The MTA and its constituent agencies should explore ways to minimize delays caused by outside agencies. Such efforts could include additional community outreach, advance planning with state environmental officials, and stronger commitments from funding partners.

SECTION TWO: ACCOMPLISHMENTS AND MAJOR PROBLEMS

THE NEW YORK CITY TRANSIT AUTHORITY

OVERVIEW

Between 1972 and 1981, the decade before the MTA Capital Program began, the Transit Authority's investment in its capital facilities and equipment was, in its own words, "strikingly meager." Excluding the ill-fated \$1.3 billion new routes program, the TA's total capital investment was just \$3 billion, about \$300 million per year. This was clearly insufficient. In 1980, the MTA estimated the TA would have to spend \$12.5 billion during the following ten years on capital revitalization. That, the MTA believed, would be enough to restore the transit system to a state of good repair by the end of the decade. This estimate of how much would have to be spent has proven to be far too low.

The predictable consequence of TA underinvestment in its capital assets was that by 1980 many of its facilities, and much of its infrastructure and equipment, were past their useful life. For example, almost one-quarter of the TA's buses were at least 12 years old, the accepted life span of a passenger bus. Many of the depots where the TA stored its 4,560 buses had been built for other purposes and were ill-equipped to provide adequate bus maintenance. Eight were constructed between 1885 and 1918 for uses other than as bus depots.

The TA's shops and barns were incapable of adequately maintaining more than 6,000 subway cars. Twenty-two car storage yards lacked sufficient space to house the entire fleet and were accessible to vandals. Consequently, nearly all of the fleet was covered with graffiti. More importantly, the cars were not being properly maintained so the average distance they travelled before breaking down was just 6,700 miles, less than one-third of what it had been ten years earlier.

The TA's basic infrastructure -- more than 700 miles of track; 287 pump plants; 199 emergency ventilation fan plants; the tunnel lighting, signal, and communication systems; and even some of the elevated and subway structures themselves -- also needed repairs or replacement. All but a few fans were past their useful life and were antiquated, as were the tunnel lighting system, almost half the signal system, and two-thirds of all mainline track.

Progress Toward A State Of Good Repair

Then-MTA Chairman Richard Ravitch stated in November 1980 that the MTA Capital Program would have "one simple objective: To restore the system to a state of good repair so that we can provide the quality of service the public wants and to which it is entitled." In November 1983, the Transit Authority predicted that "a large portion of the transit system would reach a state of good repair by 1990," and that just four transit system components -- tunnel lighting, stations, signals, and switches -- would not reach a state of good repair by 1993.

The TA's efforts to achieve a state of good repair have had mixed results. While the TA has brought its buses, subway cars, and mainline track to a state of good repair, its efforts elsewhere have not been as successful. In other Capital Program areas, particularly stations, the TA's timetable for achieving a state of good repair has slipped.

In addition, the TA plans to spend a significant amount of money on other than state of good repair projects between 1992 and 1996. More than 20 percent of all proposed 1992-96 expenditures, for example, are for purposes other than achieving a state of good repair and replacing overage equipment. This is especially true of the stations program. Of \$1.7 billion in planned station improvements, \$447 million (27 percent) is for purposes other than achieving a state of good repair, primarily improvements associated with the Automated Fare Collection Program.

The subway car program, on the other hand, has focused primarily on the achievement of a state of good repair. By the end of 1991, the TA will have committed more than \$12 billion in Capital Program funds. Almost one-third of this money, \$3.9 billion, was spent on subway cars and the TA believes its car fleet will reach a state of good repair in early 1992 (see Table 1).

**TABLE 1: 1982-91 Transit Authority Capital Program
(\$ in millions)**

| Category | 1982-86 | | 1987-91 | | Total | |
|--------------------------|------------|---------|------------|---------|-------------|---------|
| | Amount | Percent | Amount | Percent | Amount | Percent |
| New Cars | \$ 1,594.1 | 27.8 | \$ 283.0 | 4.3 | \$ 1,877.2 | 15.3 |
| Car Overhauls | 843.4 | 14.7 | 1,166.9 | 17.9 | 2,010.3 | 16.4 |
| Buses | 335.5 | 5.8 | 153.8 | 2.4 | 489.3 | 4.0 |
| Passenger Stations | 243.4 | 4.2 | 726.5 | 11.1 | 969.8 | 7.9 |
| Track | 520.9 | 9.1 | 782.1 | 12.0 | 1,303.0 | 10.6 |
| Line Equipment | 106.3 | 1.9 | 449.5 | 6.9 | 555.7 | 4.5 |
| Line Structures | 201.3 | 3.5 | 410.6 | 6.3 | 611.9 | 5.0 |
| Signals & Communications | 339.7 | 5.9 | 608.0 | 9.3 | 947.7 | 7.7 |
| Power | 230.9 | 4.0 | 262.3 | 4.0 | 493.2 | 4.0 |
| Shops | 327.5 | 5.7 | 266.0 | 4.1 | 593.5 | 4.8 |
| Yards | 194.3 | 3.4 | 110.8 | 1.7 | 305.1 | 2.5 |
| Depots | 194.3 | 3.4 | 455.2 | 7.0 | 649.4 | 5.3 |
| Service Vehicles | 65.4 | 1.1 | 50.0 | 0.8 | 115.4 | 0.9 |
| Security Systems | 24.6 | 0.4 | 17.8 | 0.3 | 42.4 | 0.4 |
| New Routes | 173.0 | 3.0 | 99.6 | 1.5 | 272.5 | 2.2 |
| Emergency/Miscellaneous | 305.5 | 5.3 | 579.4 | 8.9 | 885.0 | 7.2 |
| TA Subtotal | \$ 5,700.2 | 99.2 | \$ 6,421.2 | 98.3 | \$ 12,121.4 | 98.7 |
| SIRTOA | 443.9 | 0.8 | 111.0 | 1.7 | 554.9 | 4.5 |
| TOTAL | \$ 5,744.1 | 100.0 | \$ 6,532.2 | 100.0 | \$ 12,276.3 | 100.0 |

*May not add due to rounding.

Source: April 1991 Proposed Capital Plan Amendment

The next largest capital expenditure has been on track. Here, again, the TA's efforts have been largely successful. By the end of 1991, the TA will have spent more than \$1.3 billion on track projects and restored its 648 miles of primary mainline track to good repair. Its 1,435 mainline switches, though, are not scheduled to reach a state of good repair until 1997.

The TA's stations also received a significant infusion of funds during the first two Capital Programs but without the same positive results. Following \$243 million in station commitments from 1982-86, the TA tripled station commitments -- to \$727 million -- during the 1987-91 program. Much of this increase resulted not from the desire to restore the stations to a state of good repair, but from the realization in 1989 that AFC would be much more expensive than originally envisioned.

Plans to restore its stations to a state of good repair have met with one setback after another. Various station projects have suffered long delays and cost overruns. As a result, the TA does not expect its stations to reach a state of good repair until 2009. Based on the TA's track record, we believe even this date is optimistic.

The TA has also slipped in its schedule to bring such infrastructure items as line equipment, power equipment and its signal system to a state of good repair. Its shops, yards and depots have suffered a similar fate. Much of this slippage has been caused by increasing project costs and associated shifts in planned funding commitments.

The result has been schedule slippage in all capital program categories except subway cars, buses, and track. Table 2 shows when the TA expected to achieve a state of good repair in 11 Capital Program areas as of November 1983, March 1986, February 1990, and April 1991. In some areas, slippage has been substantial. The projected timetable for achieving a state of good repair slipped nine years for signal equipment, 13 years for line equipment, 18 years for shops, and 20 years for yards.

TABLE 2: Slippage In Achieving A State Of Good Repair, 1983-91

| <u>Category</u> | <u>Anticipated Achievement of a State of Good Repair as of:</u> | | | |
|----------------------------|---|-----------------------|--------------------------|-----------------------|
| | <u>November 1983</u> | <u>March 1986</u> | <u>February 1990</u> | <u>March 1991</u> |
| Cars | 1988 | 1990 | 1992 | 1992 |
| Buses | 1989 | 1986 | 1986 | 1986 |
| Passenger Stations | Post-1993 | Post-2006 | 2009 | 2009 |
| Track (Mainline) | 1993 | 1992 | 1991 | 1991 |
| Line Equipment | 1993* | 2001* | 2001 | 2006 |
| Line Structures (Elevated) | N/A | 2000 | 2001 | n/a |
| Signals | 2003 | 2012 | 2009 | 2012 |
| Power | 1993 | 1999 | 1999 | 1999 |
| Shops | 1988 | 1997 | 2001 | 2006 |
| Yards | 1994 | 1998 | 2012 | 2014 |
| Depots | 1993 | 1992 | 1997 | 1997 |

* All line equipment except tunnel lighting.

Source: TA 1984-93, 1987-2006, and 1992-2011 Capital Needs Assessments; proposed 1992-6 Capital Plan

Policy-makers, including the MTA Board, Capital Program Review Board, and the Legislature, should assess whether the TA's schedule for achieving a state of good repair, especially for such critical infrastructure and equipment as tunnel fans and pumps, signals, and yard tracks, is appropriate given the Capital Program's principal goal of preventing a recurrence of the deterioration that characterized the system in the 1970s.

Program Erosion Due to Unrealistic Budget Estimates

Delays in reaching a state of good repair do not appear to be solely due to construction delays. Indeed, we found that construction delays are lessening (see Table 3). However, there has been a noticeable pattern of projects in the infrastructure and maintenance facility categories being deferred as projects in these and other categories increase in cost. These cost increases, except in the station and maintenance shop categories, are not generally due to construction cost increases, but to low cost estimates and increasing TA labor and construction administration costs.

TABLE 3: Average Construction Delays in Capital Program

| <u>Category</u> | <u>Average Delay (In Months)</u> | | |
|------------------------|----------------------------------|----------------|----------------|
| | <u>1982-84</u> | <u>1985-87</u> | <u>1988-90</u> |
| Stations | 25 | 20 | 1 |
| Track | ** | 3 | * |
| Line Equipment | 22 | 11 | 8 |
| Line Structures | 3 | 4 | ** |
| Signals/Communications | 11 | 10 | 2 |
| Power | 8 | 8 | 1 |
| Shops | 17 | 3 | 6 |
| Yards | 19 | 9 | 2 |
| Depots | 12 | 12 | 7 |

* Insufficient number of projects to calculate average delay

** Completed ahead of schedule

Source: TA Engineering and Construction Department

The TA's 1987-91 Capital Program allocated over \$6.6 billion to 16 categories of transit operations, and to the Staten Island Rapid Transit Operating Authority (SIRTOA). The five-year budget was based on the TA's estimate of what it would cost to meet specific goals in each category. Table 4 provides a breakdown of the 1987-91 Capital Program budget by category.

TABLE 4: 1987-91 Planned TA Commitments as of March 1987
(\$ in millions)

| <u>Category</u> | <u>Planned 1987-91 Commitments</u> | <u>Percent of Total</u> |
|------------------------|--|-----------------------------|
| New Cars | \$ 300.9 | 4.5 |
| Car Overhauls | 1,097.8 | 16.5 |
| Buses | 203.0 | 3.0 |
| Passenger Stations | 458.2 | 6.9 |
| Track | 706.2 | 10.6 |
| Line Equipment | 355.8 | 5.3 |
| Line Structures | 454.6 | 6.8 |
| Signals/Communications | 677.6 | 10.2 |
| Power | 354.0 | 5.3 |
| Shops | 327.9 | 4.9 |
| Yards | 320.9 | 4.8 |
| Depots | 564.6 | 8.5 |
| Service Vehicles | 40.8 | 0.6 |
| Security Systems | 18.6 | 0.3 |
| New Routes | 78.7 | 1.2 |
| Miscellaneous | <u>630.2</u> | <u>9.5</u> |
| Total | <u>\$ 6,589.8</u> | <u>99.0</u> |
| SIRTOA Total | <u>\$ 68.8</u> | <u>1.0</u> |
| GRAND TOTAL | <u>\$ 6,658.6</u> | <u>100.0</u> |

Source: March 1987 Capital Plan

In the four years since its approval, the 1987-91 Capital Program has undergone many changes. The December 1990 proposed Capital Program Amendment estimated that approximately \$6.5 billion would actually be committed to capital projects, about \$127 million (2 percent) less than the TA's initial estimate. This relatively small overall decrease in the budget masks major changes that took place during the first four years of the 1987-91 program.

The TA reduced planned commitments in ten categories by \$682.4 million. Most of these decreases were in infrastructure (e.g., signals, power, line structures) and maintenance facility (e.g., shops, depots, yards) categories (see Table 5).

TABLE 5: Decreases in Planned Capital Commitments, 1987-91
(\$ in millions)

| Category | Planned Commitments | | Budget Decrease | |
|------------------------|---------------------|-------------------|------------------|--------------|
| | (3/87) | (12/90) | Amount | Percent |
| Yards | \$ 320.9 | \$ 110.8 | \$ 210.1 | 65.5 |
| Depots | 564.6 | 455.2 | 109.4 | 19.4 |
| Power | 354.0 | 264.7 | 89.3 | 25.2 |
| Signals/Communications | 677.6 | 608.4 | 69.2 | 10.2 |
| Shops | 327.9 | 266.9 | 61.0 | 18.6 |
| Buses | 203.0 | 153.8 | 49.2 | 24.2 |
| Line Structures | 454.6 | 406.3 | 48.3 | 10.6 |
| Miscellaneous | 630.2 | 603.0 | 27.2 | 4.3 |
| New Cars | 300.9 | 283.0 | 17.9 | 5.9 |
| Security Systems | <u>18.6</u> | <u>17.8</u> | <u>0.8</u> | <u>4.3</u> |
| TOTAL | \$ 3,852.3 | \$ 3,169.9 | -\$ 682.4 | -17.7 |

Source: December 1990 Proposed Capital Plan Amendment

These reductions represent a significant scaling back of capital improvements in these areas. The overall drop in planned commitments was comprised primarily of project deferrals.* Ninety-eight projects valued at \$1.22 billion were deferred in these areas while 82 projects valued at \$510 million were added. Consequently, the TA's 1987-91 Capital Program calls for the construction and/or rehabilitation of fewer shops, yards, depots, signal components, and power installations than when the budget was first approved in March 1987.

These reductions were partially offset by a \$555.1 million increase in planned commitments in six other categories and SIRTOA. On average, commitments in these categories rose 20 percent over the TA's original plan. The largest increase, \$246.7 million (54 percent), was in the TA's Capital Program for stations (see Table 6).

* We identified, by project number, all individual projects appearing in the 1987 Capital Plan and the 1988, 1989, 1990, and 1991 Plan Amendments. Projects represented by project numbers which appeared in any of these documents and then dropped out are considered to have been deferred. In some cases this pattern signifies a change in scope or method, rather than the deferral of the project to a later Capital Program or its elimination altogether.

TABLE 6: Increases in Planned Capital Commitments, 1987-91
(\$ in millions)

| Category | Planned Commitments | | Budget Increase | |
|--------------------|---------------------|-------------------|-----------------|-------------|
| | (3/87) | (12/90) | Amount | Percent |
| Passenger Stations | \$ 458.2 | \$ 704.9 | \$ 246.7 | 53.8 |
| Line Equipment | 355.8 | 449.2 | 93.4 | 26.3 |
| Track | 706.2 | 780.2 | 74.0 | 10.5 |
| Car Overhaul | 1,097.8 | 1,166.7 | 68.9 | 6.3 |
| New Routes | 78.7 | 99.6 | 20.9 | 26.6 |
| Service Vehicles | 40.8 | 49.8 | 9.0 | 22.1 |
| SIRTOA | <u>68.8</u> | <u>111.0</u> | <u>42.2</u> | <u>61.3</u> |
| TOTAL | <u>\$ 2,806.3</u> | <u>\$ 3,361.4</u> | <u>\$ 555.1</u> | <u>19.8</u> |

Source: December 1990 Proposed Capital Plan Amendment

While some of these increases can be attributed to the expansion of capital goals, particularly in the stations category, most resulted from an initial underestimation of project costs. Within the categories listed, the TA deferred 95 projects worth \$526 million, while adding 125 projects worth \$627 million. However, most of the increase resulted from the rising cost of individual projects. Planned commitments for 88 of these projects rose by \$654 million, while just 51 projects experienced a drop in planned commitments totalling \$199 million.

The majority of 1987 projects which were still in the program as of December 1990 increased in cost. Overall, the TA deferred 193 projects worth \$1.745 billion while adding 207 projects worth \$1.137 billion. Most of the \$608 million difference went to projects that increased in cost. There was a \$1.302 billion increase in planned commitments for 166 projects, an \$821 million decrease in planned commitments for 104 projects, and a \$127 million drop in total program funding.

The TA should improve its process for preparing budgets and cost estimates to avoid underestimation, project deferrals, and large cost increases over the life of many capital projects.

Construction and Engineering Support Cost Increases

Increasing project costs is not the only reason that capital monies will not go as far as expected. A fundamental reason why the TA will be able to purchase less than envisioned is that it has had to pay more than expected for engineering support and construction administration.

To facilitate our analysis, we divided the capital budget into construction/procurement and engineering support costs. Construction/procurement costs are the amount required to actually provide a capital improvement. Such costs have two main components: contract cost, or the cost of contracts to purchase goods and services from private vendors, and TA labor costs, or the cost of TA workers carrying out capital projects themselves and supporting the work of contractors.

Engineering support costs are made up of design costs -- the cost of surveys, blueprints, specifications, and other design activities undertaken prior to capital construction, rehabilitation, and/or purchases -- and construction administration costs, which include the cost of project managers, engineers, inspectors and other services related to the administration of capital projects.

In 1987, the TA estimated that the construction/procurement and engineering support costs related to its 1987-91 Capital Program would be almost \$6.3 billion (see Table 7).

TABLE 7: 1987 TA Estimate of Construction/Procurement and Engineering Support Costs for the 1987-91 Capital Program
(\$ in millions)

| | <u>1987-91 Budget</u> |
|---------------------------------------|---------------------------|
| <u>Construction/Procurement Cost:</u> | |
| Contracts | \$ 4,979.7 |
| TA Labor | <u>632.2</u> |
| | <u>\$ 5,611.9</u> |
| <u>Engineering Support Costs:</u> | |
| Design | \$ 228.5 |
| Construction Administration | <u>416.3</u> |
| | <u>\$ 644.8</u> |
| TOTAL | <u>\$ 6,256.7*</u> |

* An additional \$300 million was allocated to contingency and reserve accounts, bringing the total capital budget to almost \$6.6 billion.

Source: TA Capital Planning and Strategic Planning Division

Changes in TA Contract and In-House Labor Costs. According to May 1991 TA estimates, capital commitments for contractual costs for the 1987-91 Capital Program will be \$4.4 billion or \$542.2 million (11 percent) less than the initial 1987 estimate. This net decrease is due to a \$865.4 million decrease in planned commitments for contractual costs in ten TA categories and a \$323.2 million increase in six other categories and SIRTOA (see Table 8).

TABLE 8: Changes in Planned TA Contract Costs, 1987-91
(\$ in millions)

| Category | Initial | Current | Difference | |
|-----------------------|--------------------|--------------------|------------------|--------------|
| | Estimate (3/87) | Estimate (5/91) | Amount | Percent |
| Increases: | | | | |
| Passenger Stations | \$ 345.5 | \$ 468.1 | \$ 122.6 | 35.5 |
| Car Overhaul | 844.3 | 950.9 | 106.6 | 12.6 |
| Line Equipment | 238.4 | 297.2 | 58.8 | 24.7 |
| New Routes | 36.2 | 46.2 | 10.0 | 27.6 |
| Security Systems | 12.0 | 12.8 | 0.8 | 6.7 |
| Service Vehicles | 34.3 | 35.1 | 0.8 | 2.3 |
| SIRTOA | <u>56.4</u> | <u>80.0</u> | <u>23.6</u> | <u>41.8</u> |
| | <u>\$ 1,567.1</u> | <u>\$ 1,890.3</u> | <u>\$ 323.2</u> | <u>20.6</u> |
| Decreases: | | | | |
| Track | \$ 598.8 | \$ 424.4 | -\$ 174.4 | -29.1 |
| Yards | 249.3 | 77.9 | -171.4 | -68.8 |
| Depots | 460.4 | 327.8 | -132.6 | -28.8 |
| Miscellaneous | 400.8 | 280.2 | -120.6 | -30.1 |
| Power | 278.8 | 183.1 | -95.7 | -34.3 |
| Signals/Communication | 472.1 | 416.1 | -56.0 | -11.9 |
| Shops | 227.7 | 179.8 | -47.9 | -21.0 |
| Buses | 175.4 | 145.2 | -30.2 | -17.2 |
| Line Structures | 289.4 | 267.4 | -22.0 | -7.6 |
| New Cars | <u>259.9</u> | <u>245.3</u> | <u>-14.6</u> | <u>-5.6</u> |
| | <u>\$ 3,412.6</u> | <u>\$ 2,547.2</u> | <u>-\$ 865.4</u> | <u>-25.4</u> |
| TOTAL | <u>\$ 4,979.7</u> | <u>\$ 4,437.5</u> | <u>-\$ 542.2</u> | <u>-10.9</u> |

Source: TA Capital Budget and Strategic Planning Division

In general, planned commitments for contractual costs have decreased not because of effective cost containment measures but because projects originally included in the 1987-91 Capital Program have been deferred or eliminated. A number of projects were deferred from the following Capital Program categories:

- Yards. Six of ten train yard rehabilitation and expansion projects were deferred.
- Signals/Communications. Twelve track miles of signal equipment modernization (16 percent of what was planned) and 38 track miles of signal enclosure modernization (49 percent of what was planned) were deferred.

- Shops. Rehabilitation of the 207th Street Overhaul Shop, as well as six Track and Structures Department shops, was deferred.
- Power. The TA deferred modernization of four substations and nine substation enclosures.
- Line Equipment. Nine of the 33 fan plants expected to be replaced were dropped from the 1987-91 program.
- Depots. Three of six depot construction projects and three of 11 depot rehabilitation projects planned for 1987-91 were deferred.

Once awarded, the average cost of a capital contract remained fairly stable in most categories. We examined all capital contracts awarded after January 1981 which were at least half completed by the end of December 1990 and compared each contract's initial cost to the TA's estimate of what the completed contract would cost after additional work and scope changes are included (see Table 9). The cost overruns were greatest in the stations and shops categories.

TABLE 9: Changes in Contract Cost After Award, 1982-90
(\$ in millions)

| <u>Category</u> | <u>Changes In</u> <u>Contracts Awarded</u> <u>1982-84</u> | | <u>Changes In</u> <u>Contracts Awarded</u> <u>1985-87</u> | | <u>Changes In</u> <u>Contracts Awarded</u> <u>1988-90</u> | |
|-----------------|---|----------------|---|----------------|---|----------------|
| | <u>Amount</u> | <u>Percent</u> | <u>Amount</u> | <u>Percent</u> | <u>Amount</u> | <u>Percent</u> |
| Stations | \$ 7.30 | 9.8 | \$ 8.30 | 15.4 | \$ 0.74 | 4.3 |
| Track | 3.02 | 5.2 | 2.84 | 1.6 | 0.00 | 0.0 |
| Line Equipment | 2.69 | 8.8 | 5.68 | 4.9 | 1.05 | 5.4 |
| Line Structure | 5.48 | 8.9 | 4.02 | 3.8 | 3.75 | 5.9 |
| Signals | 1.26 | 2.0 | 1.34 | 1.2 | 0.89 | 6.4 |
| Power | 0.50 | 1.9 | 0.95 | 3.2 | 0.39 | 2.5 |
| Shops | 4.76 | 10.3 | 18.65 | 15.0 | 16.97 | 15.3 |
| Yards | 5.65 | 8.9 | 2.71 | 5.4 | 0.85 | 5.0 |
| Depots | <u>0.29</u> | <u>0.5</u> | <u>-8.61</u> | <u>-5.5</u> | <u>3.30</u> | <u>6.0</u> |
| TOTAL | \$ 30.95 | 6.6 | \$ 35.88 | 3.8 | \$ 27.94 | 8.9 |

Source: TA Engineering and Construction Department

TA labor costs for the 1987-91 Capital Program have increased by \$224.7 million (36 percent) since 1987 (see Table 10).

TABLE 10: Changes in TA Labor Costs, 1987-91
(\$ in millions)

| Category | Initial Estimate (3/87) | Current Estimate (5/91) | Difference | |
|------------------------|-------------------------------|-------------------------------|------------------|------------|
| | | | Amount | Percent |
| Increases: | | | | |
| Track | \$ 77.2 | \$ 317.2 | \$ 240.0 | 311 |
| Passenger Stations | 34.1 | 86.0 | 51.9 | 152 |
| Line Equipment | 59.5 | 72.0 | 12.5 | 21 |
| Power | 17.2 | 25.6 | 8.4 | 49 |
| Service Vehicles | 0.1 | 2.8 | 2.7 | 1738 |
| New Routes | 1.6 | 2.4 | 0.8 | 51 |
| Depots | <u>8.7</u> | <u>9.1</u> | <u>0.4</u> | <u>4</u> |
| SIRTOA | \$ <u>3.0</u> | \$ <u>15.9</u> | \$ <u>12.9</u> | <u>430</u> |
| Subtotal | \$ <u>201.4</u> | \$ <u>531.0</u> | \$ <u>329.6</u> | <u>264</u> |
| Decreases: | | | | |
| Line Structures | \$ 90.6 | \$ 63.6 | -\$ 27.0 | -30 |
| Shops | 36.3 | 13.8 | -22.5 | -62 |
| Signals/Communications | 107.2 | 88.4 | -18.8 | -17 |
| Yards | 20.5 | 6.4 | -14.1 | -69 |
| Miscellaneous | 24.2 | 12.7 | -11.5 | -47 |
| Car overhaul | 140.9 | 132.5 | -8.4 | -6 |
| Buses | 5.5 | 3.5 | -2.0 | -36 |
| Security Systems | <u>1.1</u> | <u>.5</u> | <u>-0.6</u> | <u>-55</u> |
| Subtotal | \$ <u>426.3</u> | \$ <u>321.4</u> | -\$ <u>104.9</u> | <u>-25</u> |
| No Change | | | | |
| New Cars | \$ <u>4.5</u> | \$ <u>4.5</u> | <u>0.0</u> | <u>0.0</u> |
| TOTAL | \$ <u>632.2</u> | \$ <u>856.9</u> | \$ <u>224.7</u> | <u>36</u> |

Source: TA Capital Budget and Strategic Planning Division

The largest increase in TA labor costs occurred in the track category which rose by \$240 million or 311 percent. This was not, however, a true TA labor cost increase. When the 1987-91 Capital Program was first prepared in 1987 the cost of in-house labor for track projects was included in the same category as contracts with outside vendors. Each year, the actual cost of the in-house labor is reassigned to the in-house labor budget category. The

categories with decreases in planned commitments for TA labor were, for the most part, those that experienced overall drops in planned commitments due to project deferrals prior to contract award.

Increases in Engineering Support Costs. According to the TA's May 1991 estimates, engineering costs for the 1987-91 Capital Program will exceed \$800 million. This represents a \$163.9 (25 percent) increase over the TA's 1987 estimates. Design costs alone increased by \$93.8 million or 41 percent (see Table 11).

TABLE 11: Changes in TA Design Costs, 1987-91
(\$ in millions)

| Category | Initial Estimate (3/87) | Current Estimate (5/91) | Difference | |
|------------------------|-------------------------------|-------------------------------|-----------------|------------|
| | | | Amount | Percent |
| <u>Increases:</u> | | | | |
| Miscellaneous | \$ 55.0 | \$ 93.3 | \$ 38.3 | 52 |
| Passenger Stations | 24.9 | 53.9 | 29.0 | 117 |
| Line Equipment | 10.5 | 25.1 | 14.6 | 139 |
| Depots | 22.0 | 35.9 | 13.9 | 63 |
| Power | 8.6 | 12.5 | 3.9 | 45 |
| Shops | 18.1 | 19.3 | 1.2 | 7 |
| Service Vehicles | 0.5 | 0.8 | 0.3 | 60 |
| New Routes | 29.0 | 29.2 | 0.2 | 1 |
| Car Overhaul | 0.6 | 0.8 | 0.2 | 33 |
| New Cars | — | 0.1 | 0.1 | — |
| SIRTOA | <u>0.6</u> | <u>1.8</u> | <u>1.2</u> | <u>200</u> |
| Subtotal | <u>\$ 169.8</u> | <u>\$ 272.7</u> | <u>\$ 102.9</u> | <u>61</u> |
| <u>Decreases:</u> | | | | |
| Yards | \$ 13.5 | \$ 8.5 | -\$ 5.0 | -37 |
| Line Structures | 18.5 | 16.3 | -2.2 | -12 |
| Track | 3.5 | 2.5 | -1.0 | -29 |
| Signals/Communications | 21.3 | 20.7 | -0.6 | -3 |
| Buses | <u>1.9</u> | <u>1.6</u> | <u>-0.3</u> | <u>-16</u> |
| Subtotal | <u>\$ 58.7</u> | <u>\$ 49.6</u> | <u>-9.1</u> | <u>-16</u> |
| TOTAL | <u>\$ 228.5</u> | <u>\$ 322.3</u> | <u>\$ 93.8</u> | <u>41</u> |

Source: TA Capital Budget and Strategic Planning Division

Construction administration costs increased by 17 percent during the 1987-91 period (see Table 12). The TA's cost estimates for construction administration are based on the number of work hours project managers,

designers, engineers, inspectors and other personnel will require to administer capital projects. Construction delays increase the number of work hours required to administer contracts, thus increasing construction administration costs.

TABLE 12: Changes in TA Construction Administration Costs, 1987-91
(\$ in millions)

| Category | Initial | Current | Difference | |
|-----------------------|--------------------|--------------------|-----------------|------------|
| | Estimate (3/87) | Estimate (5/91) | Amount | Percent |
| <u>Increases:</u> | | | | |
| Passenger Stations | \$ 36.3 | \$ 55.1 | \$ 18.8 | 52 |
| Miscellaneous | 25.1 | 42.8 | 17.7 | 41 |
| Line Equipment | 34.7 | 49.5 | 14.8 | 43 |
| Track | 19.2 | 30.7 | 11.5 | 60 |
| New Routes | 3.8 | 11.5 | 7.7 | 202 |
| Signal/Communications | 48.2 | 55.7 | 7.5 | 16 |
| New Cars | 10.3 | 17.2 | 6.9 | 67 |
| Shops | 26.1 | 32.6 | 6.5 | 25 |
| Line Structures | 41.4 | 44.4 | 3.0 | 7 |
| Security Systems | 1.9 | 3.4 | 1.5 | 79 |
| Service Vehicles | 1.5 | 2.2 | 0.7 | 47 |
| SIRTOA | <u>4.0</u> | <u>9.5</u> | <u>5.5</u> | <u>138</u> |
| Subtotal | \$ <u>252.5</u> | \$ <u>354.6</u> | \$ <u>102.1</u> | <u>40</u> |
| <u>Decreases:</u> | | | | |
| Car Overhaul | \$ 54.8 | \$ 42.0 | -\$ 12.8 | -23 |
| Yards | 26.0 | 14.0 | -12.0 | -46 |
| Depots | 44.9 | 41.3 | -3.6 | -8 |
| Buses | 4.2 | 1.3 | -2.9 | -69 |
| Power | <u>33.9</u> | <u>33.2</u> | <u>-0.7</u> | <u>-2</u> |
| Subtotal | \$ <u>163.8</u> | \$ <u>131.8</u> | -\$ <u>32.0</u> | <u>-20</u> |
| TOTAL | \$ <u>416.3</u> | \$ <u>486.4</u> | \$ <u>70.1</u> | <u>17</u> |

Source: TA Capital Budget and Strategic Planning Division

The TA should act to better control construction administration and design cost increases resulting from prolonged project delays and other causes.

ANALYSIS OF CAPITAL PROGRAM CATEGORIES

SUBWAY CARS

When the first Capital Program began, the TA's more than 6,000 subway cars were in appalling condition. After years of inadequate maintenance, Mean Distance Between Failure (MDBF), the TA's principal measure of car reliability, had dropped to just 6,700 miles in 1981. In 1971 it had been over 23,000 miles. The 1982-86 and 1987-91 Capital Programs addressed the problems of the TA's car fleet with a two-part strategy: (1) the purchase of new cars, and (2) a comprehensive rehabilitation program.

The new car and car overhaul programs have been two of the TA Capital Program's most visible successes. Program costs have been kept in line, the TA's entire car fleet is expected to achieve a state of good repair in early 1992, and fleet MDBF reached 30,000 miles in January 1990.

New Car Purchases

The 1982-86 Capital Program called for the TA to purchase 1,376 cars: 1,150 R62 and R62A IRT cars, and 226 R68 IND/BMT cars. The June 1982 Capital Program submission included \$1.591 billion for these cars. The actual amount committed to contract was \$1.461 billion, \$130 million less. This \$95,000 reduction per car was due to lower than anticipated inflation and competition among more bidders than the TA had expected.

The average cost of subway cars purchased during the 1982-86 Capital Program was \$1 million per car, approximately \$40,000 per car less than the contractual price. This permitted an increase in the number of R68 (IND/BMT) cars to 425 from the original 226 (See Table 13).

TABLE 13: New Car Purchases, 1982-86
(\$ in millions)

| Car Class | Base Budget | | | Estimate At Completion | | Difference | | |
|--------------|-------------------|---------------|-----------------|---------------------------|------------|------------|------------|------|
| | Number of Cars | Total Cost | Cost Per Car | Total | Per Car | Total | Per Car | Pct. |
| R62 | 325 | \$ 300.7 | \$0.93 | \$ 317.4 | \$0.98 | \$16.7 | 0.05 | 5.6 |
| R62A | 825 | 835.1 | 1.01 | 756.7 | 0.92 | -78.4 | -0.10 | -9.4 |
| R68 | 425 | 522.4 | 1.23 | 521.0 | 1.23 | -1.4 | -0.00 | -0.3 |
| | 1,575 | \$1,658.2 | \$1.05 | \$1,595.1 | \$1.01 | \$-63.1 | \$-0.04 | -3.8 |

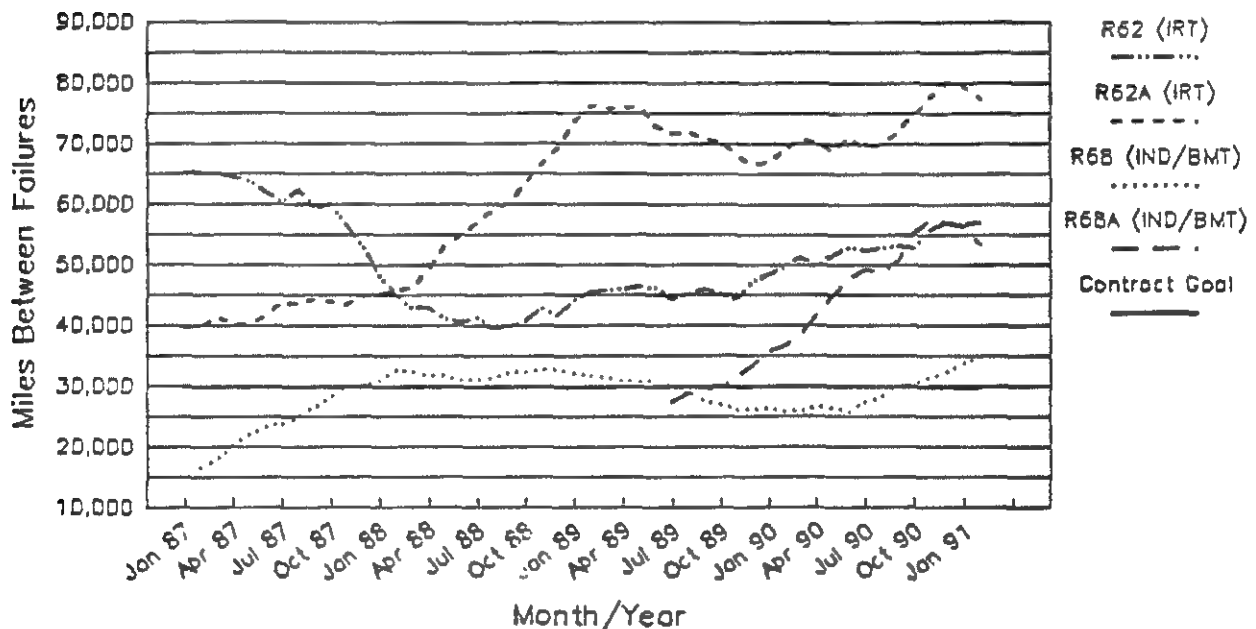
Source: TA Car Equipment Department

During the 1987-91 Capital Program, the TA contracted for 200 more R68A cars for \$237.1 million, about \$1.19 million per car. As with the R68 cars, these cars came in slightly under budget. Their actual cost was \$227.4 million, or \$1.14 million per car.

These new cars have, for the most part, performed well. New car contracts require each car to travel at least 30,000 miles without breaking down during a 30-day in-service test. Each group of new cars achieved this standard, and three of the four car classes exceeded 50,000 miles. The R68 cars, however, have not performed as well as the other new cars. They have a significantly lower MDBF than the virtually identical R68A cars.

The Transit Authority has begun to analyze why R68 car performance is not as good as R68A car performance. One explanation offered by Car Equipment Department management is that the lines the R68 car classes run on are harder on subway cars because of closer and more frequent stops than the lines the other cars run on. Another, perhaps more plausible explanation, is that the Concourse Barn, which maintains the R68A fleet, does a better job than the Coney Island Barn, which maintains most R68 cars. Indeed, R68 cars maintained at the Concourse Barn have a higher MDBF than R68A cars maintained at the same barn.

FIGURE 1: New Car MDBF, January 1987 to January 1991



We found that the R62 and R62A (IRT) cars performed better than the R68 and R68A (IND/BMT) cars. We were told that four factors probably contribute to this difference. First, there are more doors per car on IND and BMT cars, and doors fail more often than any other car system. Second, there are certain components, particularly at the operator and conductor positions, of which only one is used per train. If one of these components fails, the failure is spread out statistically over fewer car-miles since IND/BMT trains generally have fewer cars than IRT trains. Third, there are fewer motors per train on IND/BMT trains, so the train operator is more likely to notice and report a motor failure. Finally, the IND/BMT division has steeper grades than the IRT, which places a greater strain on subway cars.

Car Overhaul Program

The 1982-86 Capital Program included a major Car Overhaul Rehabilitation and Enhancement Program (CORE) to reconstruct some of the major components of the cars in the fleet. The CORE Program and other car rehabilitation and modernization work was initially funded at \$371 million and included upgrading or replacing car components to increase reliability and safety. CORE projects included door system improvements, new trucks for the R46 cars, installation of safety barriers to prevent passengers from falling between cars, and installation of safety glass.

CORE evolved into the Car Overhaul Program in 1983, and funding increased annually, eventually reaching a five-year total of \$843 million. This increase was due to the TA's decision to move away from heavy maintenance and upgrade projects, and instead give each car a complete mid-life rebuilding to "like-new" standards. The work was more extensive, so the cost per car was higher.

Actual car overhaul expenditures during the 1982-86 program have been in line with contractual costs. The only cars exceeding the initial contract cost by more than 5 percent were the R29 cars. That contract increased by \$3.8 million because 221 additional trucks were overhauled (See Table 14).

TABLE 14: Car Overhaul Program Contract Costs, 1982-86

| <u>Car Class</u> | <u>Number of Cars</u> | <u>Orig. Total (\$mil)</u> | <u>Act. Total (\$mil)</u> | <u>Total Diff. (\$mil)</u> | <u>Orig./Car (\$thou)</u> | <u>Act./Car (\$thou)</u> | <u>Diff./Car (\$thou)</u> | <u>Pct. Diff.</u> |
|--------------------|---------------------------|------------------------------------|-----------------------------------|------------------------------------|-------------------------------|------------------------------|-------------------------------|-----------------------|
| <u>Contractor</u> | | | | | | | | |
| R26, 28 | 210 | \$39.5 | \$40.8 | \$1.3 | \$188 | \$194 | \$6 | 3.2 |
| R29 | 236 | 50.2 | 54.1 | 3.8 | 213 | 229 | 16 | 7.5 |
| R32 GE | 10 | 4.9 | 4.7 | -0.2 | 490 | 470 | -20 | -4.1 |
| R36 | 300 | 30.9 | 29.9 | -1.0 | 103 | 100 | -3 | -3.0 |
| R38 | 196 | 73.9 | 73.5 | -0.4 | 377 | 375 | -2 | -0.5 |
| R40 | <u>200</u> | <u>75.2</u> | <u>72.6</u> | <u>-2.6</u> | <u>376</u> | <u>363</u> | <u>-13</u> | <u>-3.5</u> |
| Total Contractor | 1,152 | \$ 274.5 | \$ 275.6 | \$ 1.1 | \$ 238 | \$ 239 | \$ 1 | 0.4 |
| <u>TA In-House</u> | | | | | | | | |
| R30 | 162 | n/a | 51.4 | n/a | n/a | 317 | n/a | n/a |
| R33 | 486 | 195.4 | 201.0 | 5.6 | 402 | 414 | 12 | 3.0 |
| R33S | 39 | n/a | 7.8 | n/a | n/a | 200 | n/a | n/a |
| R36 | <u>116</u> | <u>n/a</u> | <u>19.0</u> | <u>n/a</u> | <u>n/a</u> | <u>164</u> | <u>n/a</u> | <u>n/a</u> |
| Total TA In-House | 803 | \$ 195.4 | \$ 279.2 | \$ 5.6 | \$ 402 | \$ 348 | n/a | n/a |
| Total 1982-1986 | <u>1,955</u> | <u>\$ 469.9</u> | <u>\$ 554.8</u> | <u>\$ 6.6</u> | <u>n/a</u> | <u>\$ 284</u> | <u>n/a</u> | <u>n/a</u> |

n/a = not available

Source: TA Car Equipment Department

By 1987, when the second Capital Program began, the TA's goal was to have its entire fleet comprised of new and rebuilt cars by 1992. To achieve this goal, an additional \$1.17 billion was allocated for car overhauls in the 1987-91 Capital Program. Thus, planned car overhaul costs totalled more than \$2 billion from 1982 to 1991, about one-sixth of the TA's \$12 billion ten-year Capital Program.

Most of the individual car overhaul projects during the 1987-91 period were within budget (see Table 15). The most notable exception was the R42 cars. These cars cost more to overhaul than expected for several reasons. First, the TA expanded the scope of work. Among the systems which received extra work were brakes, traction motors, and propulsion gears. In addition, overhauling six collision-damaged cars raised the costs. Finally, there were additional costs due to interference from the concurrent renovation of the Coney Island Shop and the reassignment of most of the employees on the project following a job pick.

TABLE 15: Car Overhaul Program Contract Costs, 1987-91

| <u>Car Class</u> | <u>Number of Cars</u> | <u>Orig. Total (\$mil)</u> | <u>Act. Total (\$mil)</u> | <u>Total Diff. (\$mil)</u> | <u>Orig./Car (\$thou)</u> | <u>Act./Car (\$thou)</u> | <u>Diff./Car (\$thou)</u> | <u>Pct. Diff.</u> |
|--------------------|---------------------------|------------------------------------|-----------------------------------|------------------------------------|-------------------------------|------------------------------|-------------------------------|-----------------------|
| <u>Contractor</u> | | | | | | | | |
| R32-I | 290 | \$ 115.9 | \$ 117.2 | \$ 1.3 | \$ 400 | \$ 404 | \$ 5 | 1.0 |
| R32-II | 296 | 129.5 | 129.2 | -0.3 | 438 | 436 | -1 | -0.5 |
| R40 Opt | 196 | 70.1 | 71.2 | 1.1 | 357 | 363 | 6 | 1.4 |
| R42 | 286 | 112.9 | 114.6 | 1.7 | 395 | 401 | 6 | 1.5 |
| R44* | 140 | 66.4 | 74.6 | 8.2 | 474 | 533 | 59 | 12.4 |
| R46* | <u>752</u> | <u>319.3</u> | <u>338.8</u> | <u>19.5</u> | <u>425</u> | <u>450</u> | <u>26</u> | <u>6.1</u> |
| Total Contractor | 1,960 | \$ 814.1 | \$ 845.6 | \$ 31.5 | \$ 415 | \$ 431 | \$ 16 | 3.9 |
| <u>TA In-House</u> | | | | | | | | |
| R42 | 110 | 51.2 | 75.8 | 24.6 | 465 | 689 | 224 | 48.2 |
| R44 SIRT0A | 64 | 36.0 | 39.7 | 3.7 | 563 | 620 | 57 | 10.1 |
| R44* | <u>140</u> | <u>74.5</u> | <u>77.1</u> | <u>2.6</u> | <u>532</u> | <u>551</u> | <u>19</u> | <u>3.6</u> |
| Total TA In-House | <u>314</u> | <u>\$ 161.7</u> | <u>\$ 192.6</u> | <u>\$ 30.9</u> | <u>\$ 515</u> | <u>\$ 613</u> | <u>\$ 98</u> | <u>19.0</u> |
| Total 1987-1991 | <u>2,274</u> | <u>\$ 975.8</u> | <u>\$ 1,038.2</u> | <u>\$ 62.4</u> | <u>\$ 429</u> | <u>\$ 456</u> | <u>\$ 27</u> | <u>6.3</u> |

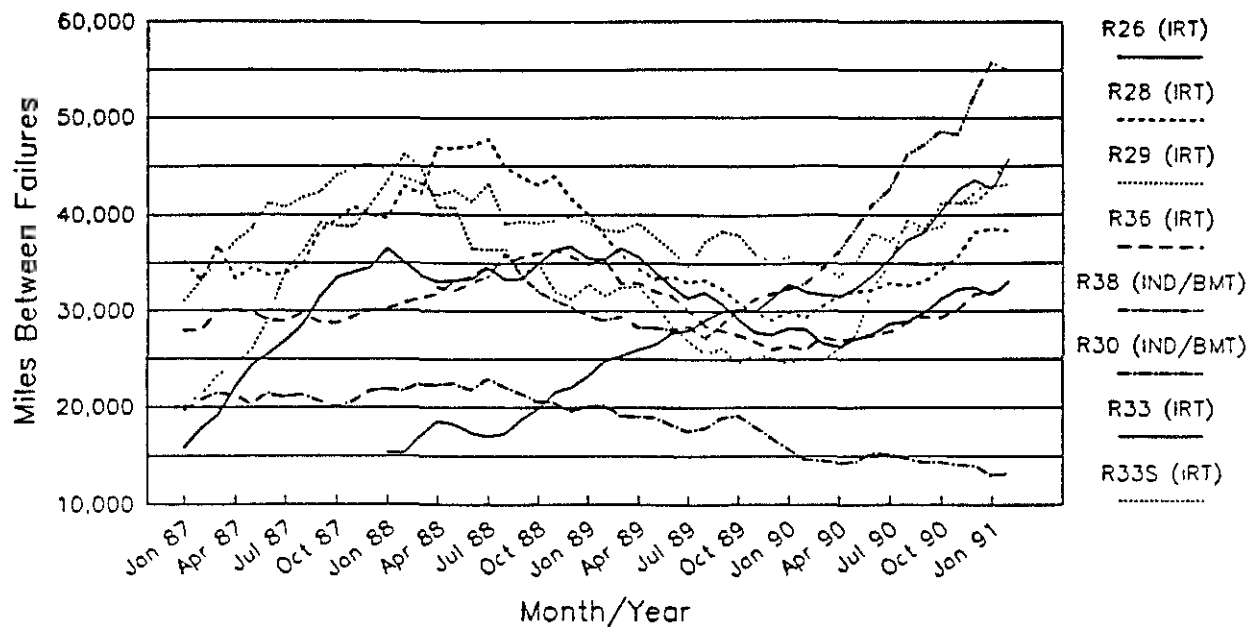
*Still in progress.

Source: TA Car Equipment Department

The R44 program, including the SIRT0A fleet, experienced significant cost overruns due to unanticipated car body corrosion and the unexpected need to repair undercarriage defects. The R46 project had cost overruns caused by the discovery and removal of asbestos in the cars.

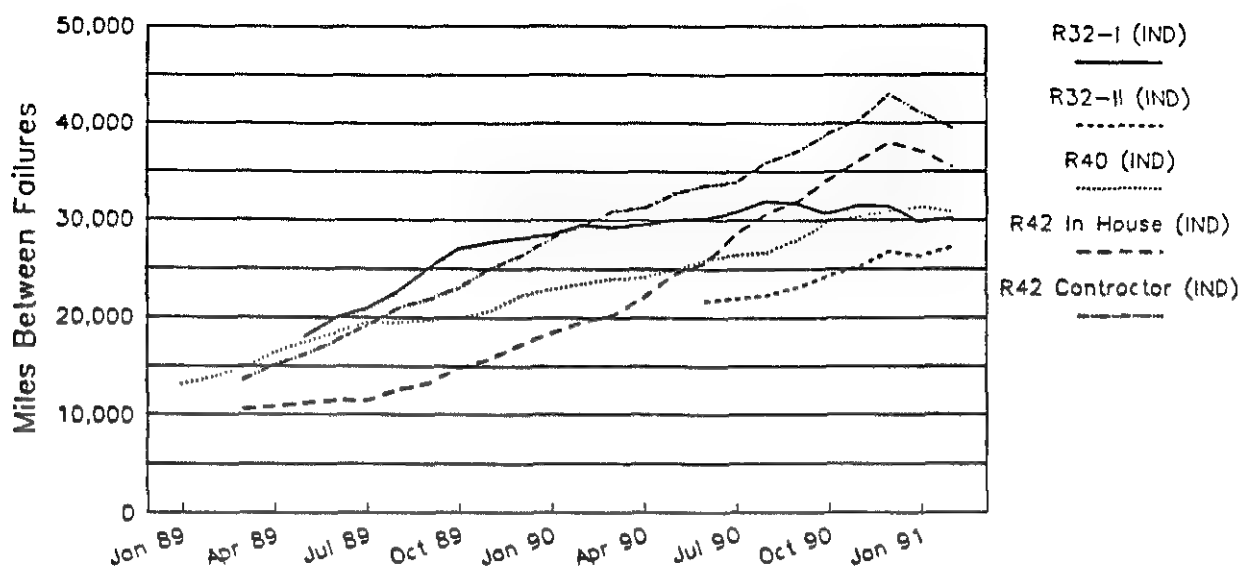
There was a noticeable decline from mid-1989 to early 1990 in the MDBF of many of the cars overhauled during the first Capital Program. We were told that three problems contributed to this occurrence; two involved the propulsion system and the third related to electrical contacts between cars. These problems were corrected under warranty at no cost to the TA and car performance has improved steadily since then. Later cars did not experience these problems.

FIGURE 2: MDBF For 1982-86 Overhauls, January 1987 to January 1991



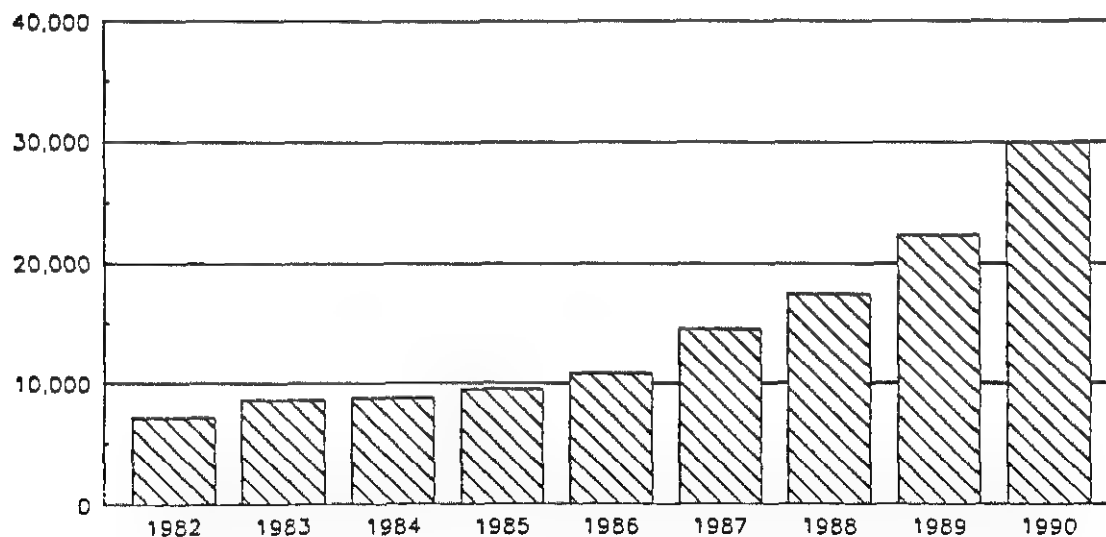
The 1987-91 Car Overhaul Program has generally been successful. It has improved car reliability, and some overhauled cars now average more than 40,000 miles between failures. The overhaul contracts called for 25,000 to 35,000 miles MDBF and all classes (except the R44 and R46 cars which are still in production, and the R32-II cars, which are still in their break-in period) have exceeded these goals. All car classes overhauled by TA workers at TA facilities have exceeded their goal of 25,000 miles between failures, except for the R30 cars. These cars were the first to be overhauled and were not completely rebuilt.

FIGURE 3: MDBF For 1987-91 Overhauls, January 1989 to January 1991



The new car and car overhaul programs have dramatically improved overall fleet reliability. MDBF has more than quadrupled from the low of 6,700 miles in 1980 to almost 30,000 miles in 1990.

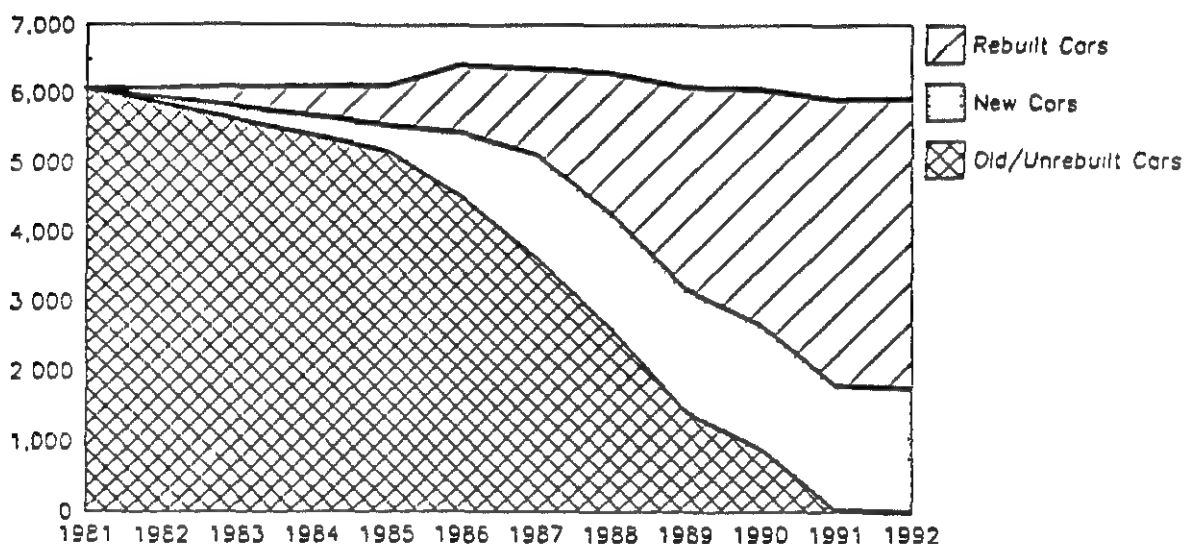
FIGURE 4: Subway Car Fleet MDBF, Annual Average, 1982-90



Progress Toward a State of Good Repair

While individual projects slipped, particularly during the first Capital Program, the last of the 4,181 cars being overhauled are scheduled to be returned to the TA in 1992. At that time, the entire TA fleet will be comprised of new or overhauled cars and the fleet will have reached a state of good repair. This is three to four years later than the overly optimistic 1983 schedule, but generally in line with more recent TA estimates.

FIGURE 5: Fleet Composition, 1981-1992



New Technology Cars

In addition to the car programs discussed above, 1987-91 Capital Program funds are being used to design and manufacture two "New Technology" trains. These trains will include state-of-the-art components to determine whether they should be incorporated into all new cars. TA management hopes these cars will have an MDBF of 100,000 miles, that they will be 15 percent less expensive to maintain, and that they will use 15 to 20 percent less electricity. The two trains are on schedule for a June 1992 delivery. After that they will be tested in revenue service. The design and manufacture of the two test trains is estimated at \$51 million.

Proposed 1992-96 Capital Program

No major car overhauls are planned for the proposed 1992-96 Capital Program and the next major new car purchases are not expected until 1997. Consequently, minimal expenditures for new or overhauled cars are planned for the 1992-96 Capital Program. To maintain a state of good repair, the TA plans to institute a "scheduled maintenance system." Under this system, subway car components and subsystems will be repaired or replaced according to a schedule based on their useful lives. Expenditures for this program are planned to total \$49.3 million during the 1992-96 Capital Program. The TA is also seeking an additional \$39 million to modernize its car door systems.

BUSES

In 1981, the TA had 4,560 buses, which carried more than 640 million passengers annually over 1,000 route miles in all five boroughs. During the preceding ten years, bus purchases were both erratic and insufficient. Consequently, by 1981, 1,178 buses (26 percent of the fleet) were more than 12 years old, the normal life span for such vehicles. MDBF for the bus fleet was just 599 miles.

Beginning in 1980, the TA began purchasing new buses. By doing so, TA management hoped to achieve and then maintain the bus industry standard of a 12-year replacement cycle. Just 573 buses were to be more than 12 years old by the end of 1986. The new buses, the TA hoped, would increase MDBF and allow the Authority to carry the same number of passengers with approximately 500 fewer buses. The TA also wanted to increase the number of buses with air conditioning and which were accessible to elderly and handicapped passengers. During the two Capital Programs the TA committed \$453.8 million for buses, as shown in Table 15:

TABLE 15: Funding Commitments for Buses, 1982-86, 1987-91
(\$ in millions)

| <u>Project</u> | <u>1987-86</u> | <u>1987-91</u> | <u>Total</u> |
|--------------------|-----------------|-----------------|-----------------|
| Bus Purchase | \$ 284.7 | \$ 128.1 | \$ 412.8 |
| Bus Rehabilitation | 34.5 | 0.0 | 34.5 |
| Retrofit A/C | 5.0 | 0.0 | 5.0 |
| Bus Testing | <u>0.0</u> | <u>1.5</u> | <u>1.5</u> |
| Total* | \$ <u>324.2</u> | \$ <u>129.6</u> | \$ <u>453.8</u> |

* Totals may not add due to rounding.

Source: December 1990 Proposed Capital Plan Amendment

Of the \$453.8 million, \$412.8 million was used to purchase 2,469 buses. When General Motors Corporation sold its bus manufacturing division to Transportation Manufacturing Corporation (TMC) in 1989, the TA spent \$1.5 million to test TMC buses. The remaining \$39.5 million was spent to rehabilitate 350 older buses and equip 274 buses with air conditioning.

The TA's original estimates for the number of buses to be purchased changed in each of the two Capital Programs, as shown in Table 16. During the 1982-86 program, the TA purchased 164 additional buses to compensate, in part, for removing 850 defective Grumman Flxible buses from its fleet. During the 1987-91 program, the TA deferred acquiring 200 buses due to delays in testing the TMC buses. However, the total number of buses purchased was within 2 percent of the original plans and their cost did not vary significantly from the original estimate.

TABLE 16: Planned and Actual Bus Purchases, 1982-91

| <u>Period</u> | <u>Planned Purchases</u> | <u>Actual Purchases</u> | <u>Difference</u> | |
|---------------|------------------------------|-----------------------------|-------------------|----------------|
| | | | <u>Number</u> | <u>Percent</u> |
| 1982-86 | 1,605 | 1,769 | 164 | 10.2 |
| 1987-91 | <u>900</u> | <u>700</u> | <u>-200</u> | <u>-22.2</u> |
| Total | <u>2,505</u> | <u>2,469</u> | <u>-36</u> | <u>-1.4</u> |

Source: September 1981 and March 1987 Capital Plans; May 1988 and March 1990 Capital Plan Amendments

The entire bus fleet reached a state of good repair in 1986, exceeding the 1983 estimate. The TA also made significant strides in improving bus MDBF, increasing the proportion of its fleet with air conditioning, and in making its buses accessible to elderly and handicapped passengers (see Table 17). During the proposed 1992-96 Capital Program, the TA plans to purchase 1,700 buses for \$444 million.

TABLE 17: Selected Bus Program Performance Indicators, 1982, 1987, 1990

| <u>Year</u> | <u>MDBF (in miles)</u> | <u>Percent of Buses With Air Conditioning</u> | <u>Percent of Buses Accessible to the Elderly and Handicapped</u> |
|-------------|----------------------------|---|---|
| 1982 | 876 | N/A | N/A |
| 1987 | 1,663 | 75 | 71 |
| 1990 | 2,553 | 88 | 79 |

Source: March 1987 Capital Plan, December 1990 Proposed Capital Plan Amendment, Proposed 1992-96 Capital Plan

PASSENGER STATIONS

The New York City subway system has 469 passenger stations. All but six of them were built between 1904 and 1930, and little was done to maintain them until the early 1980s. Consequently, many, if not most, were in poor condition when the 1982-86 Capital Program began.

The 1982-86 Capital Program included \$309 million for stations. Almost three-quarters of this money, \$227 million, was earmarked for a comprehensive Station Modernization Program. The remaining \$82 million addressed such specific problems as dilapidated platform roofs and canopies, overage turnstiles, antiquated and inadequate lighting, and poor signage.

The Capital Program for stations has been a clear-cut failure. Though planned commitments increased significantly, the program has not restored a significant number of stations to a state of good repair. The TA has tried several approaches -- modernization, restoration, rehabilitation -- but has not demonstrated an ability to substantially improve station conditions in a reasonable amount of time at a reasonable cost.

The 1982-86 Station Program fell short of its \$309 million commitment target by \$65.5 million, primarily because of the TA's inability to modernize as many stations as planned. The 1987-91 program, however, has grown considerably, from planned commitments of \$458.2 million to a December 1990 estimate of \$704.9 million (see Table 18).

**TABLE 18: 1982-86 and 1987-91 Planned Commitments and Current Estimates
(\$ in millions)**

| <u>Period</u> | <u>Planned Commitments</u> | | <u>Program Change</u> | |
|---------------|----------------------------|-------------------------------|-----------------------|----------------|
| | <u>Original Plan</u> | <u>Current Projection</u> | <u>Amount</u> | <u>Percent</u> |
| 1982-86 | \$309.0 | \$ 243.5 | -\$ 65.5 | -21.2 |
| 1987-91 | 458.2 | 704.9 | 246.7 | 53.8 |

Source: September 1981 and March 1987 Capital Programs; December 1990 Proposed Capital Plan Amendment

The \$246.7 million increase in planned 1987-91 commitments was primarily due to three program changes: a \$64 million increase in anticipated private development funds, a \$112.1 million increase in planned AFC commitments, and the addition of a \$97 million Station Rehabilitation Program. This last change resulted directly from the Station Modernization Program's failure to produce positive results at reasonable costs (see Table 19).

**TABLE 19: 1987-91 Station Category Capital Program Changes
(\$ in millions)**

| <u>Capital Program Element</u> | <u>Planned Commitments</u> | | <u>Change</u> | |
|------------------------------------|----------------------------|--------------|---------------|----------------|
| | <u>3/87</u> | <u>12/90</u> | <u>Amount</u> | <u>Percent</u> |
| Private Development | \$ 71.9 | \$ 135.9 | \$ 64.0 | 89.0 |
| Station Modernization | 235.4 | 210.0 | -25.4 | -10.8 |
| Platform Roofs/Canopies | 52.6 | 52.1 | -0.5 | -1.0 |
| AFC | 63.6 | 175.7 | 112.1 | 176.3 |
| Replace Turnstiles | 0.0 | 0.0 | 0.0 | 0.0 |
| Lighting/Emergency Power | 24.7 | 8.9 | 15.8 | 64.0 |
| Escalators/Elevators | 1.5 | 15.6 | 14.1 | 940.0 |
| Warning Strips/Misc. Rehab. | 1.7 | 7.7 | 6.0 | 352.9 |
| Station Signage | 7.0 | 2.0 | -5.0 | -71.4 |
| Station Rehabilitation | 0.0 | 97.0 | 97.0 | -- |
| Total | \$ 458.2 | \$ 704.9 | \$ 246.7 | 53.8 |

† May not add due to rounding

Source: March 1987 Capital Plan; December 1990 Proposed Capital Plan Amendment

Station Modernization Program

The Station Modernization Program, beset since its inception by construction delays and cost overruns, has been one of the most trouble-plagued areas of the TA Capital Program. As a result of inadequate program planning and development, the TA achieved much less than anticipated at a much greater per-unit cost. In 1982, the TA expected to modernize 50 stations between 1982 and 1986 for \$227 million. It now expects to modernize just 23 stations for \$220 million by the end of 1991. In addition, extensive construction delays left stations in disrepair for extended periods and inconvenienced tens of thousands of riders.

Program Delays. The TA's initial completion schedule was grossly optimistic. The 1982-86 Capital Plan called for modernizing 50 stations. By 1987, though, the TA had begun just 21 stations. Many of the original 50 stations had been deferred and the 1987-91 program concentrated on finishing work that was already underway.

When we reviewed the Station Modernization Program in 1989, 21 stations were completed or in progress. These jobs were, on average, 29 months behind schedule with delays ranging from seven months to over five and a half years. These delays were attributed to the TA's inability to manage its contractors effectively, poor consultant performance, poor planning, the use of obsolete blueprints during project design, unanticipated field conditions due to incomplete site surveys, and unrealistic work schedules.

At the time of our review, seven of the 21 modernizations were still in progress. Since then, six of these seven projects have incurred additional delays of from 8 to 13 months (see Table 20). Grand Central Station experienced the longest delay, approximately 13 months. Two modernizations started since our review: Roosevelt Avenue and Herald Square. The Roosevelt Avenue contract was awarded in April 1989 and is already six months behind schedule. Thirty months after the contract was awarded, Herald Square is still on schedule.

TABLE 20: Additional Station Modernization Completion Delays

| Station | <u>Completion Schedule</u> | | Additional Delay (Months) |
|---|----------------------------|------------------------------|---------------------------------|
| | <u>3/89 Forecast</u> | <u>Actual Completion</u> | |
| Borough Hall | 1/90 | 9/90 | 8 |
| 42nd Street/8th Avenue | 6/89 | 6/89 | 0 |
| 103rd Street/Lexington | 6/89 | 8/89 | 2 |
| Grand Central | 1/90 | 2/91 | 13 |
| 51st Street/Lexington | 8/89 | 4/90 | 8 |
| Clark Street | 3/90 | 1/91 | 10 |
| Pelham Bay Park | 10/89 | 7/90 | 9 |
| Average Delay Between March 1989 and 1991 | | | 7 |

Source: March 1989 and March 1991 TA Project Status Reports

Cost Increases. The Station Modernization Program has experienced significant cost increases which continue to this day. Nearly two-thirds of the projects, 15 of 23, rose in cost by at least 10 percent, and nine of them increased by more than 25 percent (see Table 21). The seven projects still under construction at the time of our September 1989 review increased by almost \$1 million between then and December 1990.

TABLE 21: Station Modernization Cost Changes
(\$ in millions)

| Station | Base Cost | Estimate to Completion | Change | |
|--|-------------|------------------------|-------------|------------|
| | | | Amount | Percent |
| Borough Hall-Lexington Avenue Line | \$ 2.82 | \$ 4.88 | \$ 2.06 | 73.3 |
| Hoyt Street-New Lots Line | 2.68 | 3.59 | .91 | 34.0 |
| Church Avenue-Brighton Line | 3.32 | 4.38 | 1.06 | 31.9 |
| 61st Street/Woodside-Flushing Line | 4.69 | 5.06 | .36 | 7.7 |
| 42nd Street-8th Avenue Line | 10.15 | 11.79 | 1.64 | 16.2 |
| 125th Street-8th Avenue Line | 4.58 | 4.65 | .07 | 1.5 |
| 125th Street-Lexington Avenue Line | 4.97 | 5.26 | .30 | 6.0 |
| Astor Place-Lexington Avenue Line | 4.18 | 4.95 | .77 | 18.4 |
| 23rd Street-Lexington Avenue Line | 3.62 | 4.93 | 1.32 | 36.4 |
| Fulton Street-Lexington Avenue Line | 6.81 | 6.23 | -.58 | -8.4 |
| Newkirk Avenue-Brighton Line | 2.74 | 2.93 | .19 | 6.8 |
| Kings Highway-Brighton Line | 2.86 | 2.97 | .11 | 3.9 |
| 46th & Bliss Street-Flushing Line | 2.74 | 3.89 | 1.14 | 41.7 |
| 5th Avenue/53rd Street-Queens Blvd Line | 6.68 | 8.23 | 1.55 | 23.1 |
| 103rd Street-Lexington Avenue Line | 4.46 | 6.05 | 1.59 | 35.6 |
| 137th Street-7th Avenue Line | 4.36 | 5.40 | 1.05 | 24.0 |
| Grand Central Station-Lexington Ave Line | 19.46 | 26.31 | 6.85 | 35.2 |
| 51st Street-Lexington Avenue Line | 14.60 | 17.90 | 3.30 | 22.6 |
| 34th Street-7th Avenue Line | 1.80 | 3.72 | 1.93 | 107.4 |
| Clark Street-New Lots Line | 1.79 | 2.55 | .76 | 42.1 |
| Pelham Bay Park-White Plains Road Line | 7.23 | 8.42 | 1.19 | 16.5 |
| Herald Square Complex | 63.84 | 65.85 | 2.01 | 3.1 |
| 74th Street/Roosevelt Avenue | <u>9.76</u> | <u>10.29</u> | <u>0.53</u> | <u>5.4</u> |
| Total | \$ 190.12 | \$ 220.21 | \$ 30.09 | 15.8 |

Source: TA Project Status Reports (March 1989, March 1991)

The base cost (initial cost at contract award) of all 23 station modernizations completed or in progress at the end of 1990 was \$190.1 million. By the time these projects are completed, the TA expects this figure to have increased to \$220.2 million (see Table 21). This increase is primarily due to projected increases of \$17.9 million (13.1 percent) in additional work and \$16.3 million (79 percent) in construction administration (see Table 22).

TABLE 22: Summary of Station Modernization Cost Changes
(\$ in millions)

| <u>Category</u> | <u>Base Cost</u> | <u>Estimate at Completion</u> | <u>Change</u> | |
|-----------------------------|------------------|-------------------------------|-----------------|----------------|
| | | | <u>Amount</u> | <u>Percent</u> |
| Bid and Utilities | \$ 136.97 | \$ 154.91 | \$ 17.94 | 13.1 |
| TA Labor | 9.72 | 12.90 | 3.18 | 32.7 |
| Construction Administration | 20.69 | 37.03 | 16.34 | 79.0 |
| Design | 13.87 | 14.93 | 1.05 | 7.7 |
| Contingency | <u>8.87</u> | <u>0.35</u> | <u>-8.52</u> | <u>-98.0</u> |
| TOTAL* | <u>\$ 190.12</u> | <u>\$ 220.21</u> | <u>\$ 30.09</u> | <u>15.8</u> |

* May not add due to rounding

Source: TA Project Status Reports (March 1989, December 1990, March 1991)

Condition of Completed Station Modernizations. During our review, we visited recently modernized stations to examine their condition and noticed that some of them have begun to show signs of premature deterioration. We noted water infiltration at the Newkirk Avenue, 23rd Street (Lexington Avenue Line), 53rd Street, and Astor Place stations. We observed missing, cracked, and/or patched up sections of floor and wall tiles at the Borough Hall, Grand Central, 23rd Street, and Newkirk Avenue stations. The appearance of these problems so soon after modernization calls into question the quality of work of the Station Modernization Program.

We also question the effectiveness of some of the aesthetic features incorporated into the Station Modernization Program. For example, the Grand Central Station mezzanine now has suspended ceilings. However, such ceilings are susceptible to vandalism. The 53rd Street station modernization, which was completed in April 1990, also has a hung ceiling, which has begun to show signs of wear. Moreover, suspended ceilings make determining the presence of water infiltration and other problems difficult, if not impossible.

* **Absence of Condition Survey/Failure to Prioritize.** Structural conditions were not taken into account in selecting stations to be modernized. Instead, each borough was allocated a number of modernizations based on the proportion of stations in that borough. Recommendations by the City Planning Department also played a role in station selection. Another consideration was the station's proximity to retail areas, schools, and intermodal transfer points.

While these are valid criteria, the failure to take structural conditions into account was a serious omission which was repeated when stations were selected for the Station Restoration Program. When the TA finally conducted a station condition survey in 1989, it found that 133 stations had "overwhelming" structural defects. In addition, the station condition survey did not assess the existing electrical power supply at each station. This necessitated a further survey of station power.

We also have reservations about the adequacy of the structural assessment done during the station condition survey. The April 1989 survey of the Nevins Street Station uncovered corroded steel and crumbling concrete, but failed to find immediately hazardous structural problems. However, in the summer of 1990 major structural problems were discovered and the TA was forced to award an emergency contract to reconstruct the Nevins Street Station mezzanine (see page 132).

Station Restoration/Rehabilitation Program

TA management recognized the limitations of the Station Modernization Program in 1987 and initiated the Station Restoration Program. Its goal was to return stations to a state of good repair more quickly and cheaply than under Station Modernization. All work was to be done by TA workers. Stations were initially expected to take about a year to complete and cost about \$1 million each. Like the Modernization Program before it, though, the TA began construction without adequate planning. The result was cost escalation and delays.

Because the TA did not adequately survey the stations it planned to restore, work crews often encountered unexpected problems, such as water infiltration and greater than expected structural deterioration. This created an unavoidable need to expand the scope of work at several stations and led to delays. Another reason for delays was the fact that the TA began construction without clearly defined goals. For example, it originally planned to bring each station to a state of good repair. However, the program was later expanded to include the preservation of architecturally distinct features.

The TA started ten stations in 1987 and expected to restore 20 stations annually beginning in 1988. None of the first ten stations were completed by the end of 1988, and only four of the 20 stations scheduled to begin restoration in 1988 were actually started. As of the end of March 1991, just 20 restorations have been completed; 11 in 1989, six in 1990 and three in the first quarter of 1991.

Moreover, actual costs far exceeded initial estimates. The first 30 restorations were expected to cost \$31 million. In 1989, the estimate had risen to \$54 million. The cost of the 20 restorations completed as of the end of March 1991 was almost \$40 million, twice the initial estimate.

While the Station Restoration Program was not as fast or inexpensive as the TA believed it would be, we reported in September 1989 that it had the potential to remedy the poor condition of many stations faster and cheaper than station modernization. The 28th Street and Lexington Avenue restoration cost \$2.4 million, less than half the average cost of similar stations which were modernized on that line. The 46th Street/Bliss Street modernization cost more than twice as much and took three times as long as similar elevated station restorations.

The work performed under the Station Restoration Program was also of high quality. O'Brien-Kreitzberg, the MTA's independent engineers, reviewed the Station Restoration Program and found the quality of work to be excellent. O'Brien-Kreitzberg, however, found that program costs were excessive, due primarily to unexpectedly high labor and in-house architectural and design costs.

O'Brien-Kreitzberg also found that the program was fragmented and lacked coordination between the Track and Structures, Stations, and Engineering and Construction departments. Consequently, it was recommended that the program's management structure be reorganized with Engineering and Construction coordinating, designing, scheduling and estimating the cost of in-house restorations.

The TA adopted this approach, renamed the program the Station Rehabilitation Program, and made one other significant change. Approximately half the stations to be rehabilitated would be done by contractors. By September 1990, the TA expected to rehabilitate 118 stations between 1991 and 1996. Of these, 61 were to be restored by contractors and 57 by the Track and Structures Department.

While it is too early to assess the effectiveness of the Station Rehabilitation Program as it is currently configured, problems have already begun to develop. As of May 1991, both the Track and Structures and Engineering and Construction departments staff assigned to the Station Rehabilitation Program were inadequate for the amount of work envisioned. The Program Planning and Development Unit had just two staff members and the Station Design Unit had a full-time staff of 42, approximately one-half the number of people O'Brien-Kreitzberg considered necessary. While Track and Structures was expected to do half the Station Rehabilitations, about ten stations a year, it has sufficient staff to complete only four stations annually.

The Deputy Vice President in charge of the Station Rehabilitation Program told us that the TA was waiting to see how much money would be available for the 1992-96 program before hiring additional workers. He said that projects deleted from the in-house program would be performed by contractors if capital funding is available. If funding is not available, these projects will be eliminated from the 1992-96 program. As a result of these problems, the number of stations that will reach a state of good repair by 1996 may be significantly fewer than the 118 stations the TA expected to rehabilitate.

Automated Fare Collection Program

In 1983, the TA added an AFC component to its Capital Program and \$80 million was set aside to design and install AFC systemwide by 1990. Since then, the cost of AFC has soared. The 1987-91 program budgeted \$154.8 million for AFC, including station power improvements, and the 1992-96 program proposes to spend approximately \$420 million on AFC and power improvements. The TA has justified this expenditure largely on the basis of anticipated increased revenue. It has asserted that AFC would reduce subway fare evasion, increasing revenue by \$41 million annually, allow the TA to offer flexible pricing options, increasing revenue by \$10 to \$50 million annually, and boost passenger convenience, increasing revenue by \$15 million annually.

* This type of analysis is of the utmost importance in deciding whether to fund projects which are not necessary to restore the system to a state of good repair. Accordingly, the New York State Transportation Commissioner requires such an evaluation in his capacity as Chairman of the Capital Program Review Board (CPRB).

Besides being a CPRB requirement, comparing a project's cost to its probable financial return is sound management. It is vital to those responsible for deciding whether to undertake the project, including the top management of

the operating authority, the MTA Board, the State Legislature, and the review board itself. Consequently, we reviewed the documentation underlying the TA's AFC benefit-cost analysis. We found that there is little empirical support for the TA's projections of increased revenue.

To determine whether AFC and the other improvements included in the Fare Collection Modernization Program reduced fare evasion and increased paid ridership, the TA computed both daily fare evasion and daily ridership at one of the 18th Street IRT station's two fare control areas during two one-month-long periods. First, fare evasion and ridership were computed during the month of September 1988 before any improvements were made to the fare control area. Then, the TA installed three T-200 "AFC" turnstiles. We were told that fare evasion due to backcocking was reduced, but that people continued to evade the fare by vaulting the low gates and railings.

Following installation of floor-to-ceiling railings and gates, fare evasion was further reduced. In January 1989 it dropped from 14.6 percent of paying passengers to 2.1 percent, and the number of paying passengers increased by 9.1 percent. This means that 60 percent of the prior fare evaders, when confronted with "hardened" fare control areas, paid the fare. The TA extrapolated these results, which included fewer than 10,000 riders and 800 fare evaders at one station during a two-month period, to the remaining 468 stations. Based on that extrapolation, the TA asserts that AFC will increase subway revenue by \$41 million annually.

This methodology is flawed in several respects. First, fare evasion rates can and probably do differ by location. Thus, there is little reason to believe that the results at 18th Street are representative of what would happen following systemwide implementation of AFC. Second, the analysis did not take seasonal variations into account. Finally, three million people a day use the subway and, by the TA's own estimate, 60 million people evade the fare each year. We believe it is inappropriate to extrapolate statistics based on so small and unrepresentative a sample to so large a population.

The test also did not really involve AFC technology. The T-200 turnstiles used in the test were not equipped with AFC electronics, but with regular token slots, and the T-200 turnstiles are not as fare evasion resistant as TA management believed. Two members of the Inspector General's Office were able to enter the system by backcocking, vaulting over, and crawling under the turnstiles without difficulty. Similar observations have been made by others. The drop in fare evasion at 18th Street appears to have been due more to the hardening of the control area than to AFC, and could probably be achieved without the expenses associated with AFC.

The TA's assertion that flexible pricing and improved marketing opportunities will increase subway revenue by \$10 million to \$50 million annually also lacks empirical support. To determine the impact of reduced off-peak fares, the TA applied the results of several consultant studies of previous fare increases on total ridership. Based on these analyses, the TA estimated that flexible pricing would yield \$10 million to \$50 million annually in additional revenue. This analysis is highly questionable.

The TA has limited information on the impact of decreasing fares on ridership. Therefore, TA analysts assumed that revenue would increase as much if off-peak fares were reduced as it decreased after an equivalent fare increase. However, it does not logically follow that decreasing off-peak fares will cause revenue to rise as much as increasing all fares causes it to drop. Indeed, a February 28, 1990 TA Revenue Budget Department assessment of that methodology concluded that "the elasticities are assumed the same for increasing and decreasing fares. This is probably not true"

That same internal assessment stated that "in-house research on peak and off-peak elasticity, based on hourly ridership counts provided inconclusive and counter-intuitive results More information needs to be acquired for more precise ridership and revenue estimates."

TA statements that AFC will be more convenient than the current system and that this will result in an annual revenue increase of \$15 million also lack support. Briefing materials prepared for the MTA Board assert that "the AFC system will improve passenger convenience by allowing (the TA) to better understand the travel patterns of our patrons ... enabling the authority to greatly improve its service" Based on this, the TA further asserted:

We believe that all of these features cannot help but attract new ridership to the system; only the amount remains difficult to quantify. For purposes of illustration, however, were the System to attract a mere 1% increase in new ridership, Rapid revenue at today's prices would increase \$9 million, and Surface revenue by \$6 million. A 2% increase would double these estimated returns.

While this figure was merely illustrative, it has since been incorporated into the TA's benefit-cost analysis for AFC. We believe this \$15 million figure could be misleading if policy-makers assume that it is derived from rigorous studies.

Given the huge amount of money still needed to restore the transit system to a state of good repair, evaluating the benefit-cost relationship on non-state of good repair projects is extremely important. All such analyses should be firmly rooted in objective -- preferably empirical -- studies. The TA must strive to achieve this standard and MTA staff must carefully review all benefit-cost analyses to ensure it is achieved.

Other Station Programs

In addition to modernization and restoration, other programs were undertaken to address specific station problems. They include the replacement of platform roofs and canopies, station lighting improvements, and the replacement of overage elevators and escalators.

The TA planned to initiate six projects to replace 35 platform roofs and canopies during the 1987-91 Capital Program. Three of the six projects were eventually dropped. The three remaining projects, the Dyre Avenue Line, the Myrtle Avenue Line, and the Rockaway Line, have substantially increased in price. Not only did the cost of the Rockaway Line increase, but the number of stations was reduced. The 1987 plan included ten stations, but the 1991 plan included just six (see Table 23).

TABLE 23: Platform Roofs and Canopies
(\$ in millions)

| Project | Planned Commitments | | Change | | No. of Stations | |
|-----------------------------|---------------------|----------------|----------------|---------------|-----------------|------------|
| | March 1987 | Dec. 1990 | Amount | Pct. | 3/87 | 12/90 |
| Dyre Avenue Line | \$ 6.8 | \$ 23.3 | \$ 16.5 | 242.6 | 2 | 3 |
| Jamaica/Myrtle Avenue Lines | 7.5 | 14.6 | 7.1 | 94.7 | 15 | 7 |
| Rockaway Line | 13.9 | 14.2 | 0.3 | 2.2 | 10 | 6 |
| Prospect Park Line | 8.4 | 0.0 | -8.4 | -100.0 | 2 | 0 |
| Brighton Line | 9.7 | 0.0 | -9.7 | -100.0 | 6 | 0 |
| Remove Windscreens | <u>6.3</u> | <u>0.0</u> | <u>-6.3</u> | <u>-100.0</u> | <u>n/a</u> | <u>n/a</u> |
| TOTAL | <u>\$ 52.6</u> | <u>\$ 52.1</u> | <u>-\$ 0.5</u> | <u>-1.0</u> | <u>35</u> | <u>16</u> |

Source: March 1987 Capital Plan, December 1990 Proposed Capital Plan Amendment

The TA expected to award four contracts to improve lighting at 32 stations during the 1987-91 program at an expected cost of \$24.7 million. This goal will not be met. Two projects, the BMT Division project (16 stations) and the Broadway/Jamaica Line project (2 stations), were eliminated from the program. The Pelham Line Project has been reduced from 11 stations to six and is on hold pending the sale of the New York Coliseum.

Planned commitments for replacing elevators and escalators increased dramatically during 1987-91. A \$1.5 million Bowling Green escalator project was replaced by a \$15.3 million project to replace eight escalators at various locations. This project is also on hold pending the sale of the New York Coliseum.

Progress Toward a State of Good Repair

In its February 1990 Needs Assessment, the TA estimated that 91 stations would begin to be brought to a state of good repair by 1991, and that 122 more would begin modernization or restoration between 1992 and 1996. By September 1990, the projected number of stations expected to begin modernization or restoration between 1992 and 1996 had dropped slightly to 118 stations. These projections are far from firm.

The number of in-house restorations expected to be undertaken from 1987-91 has been reduced from 53 to 29. Moreover, existing in-house planning, design, and construction staffs are insufficient to design 106 stations and carry out construction on half of these. While we were told the TA would staff up if capital monies become available, it will not know how much money is available until early 1992. Thus, it will almost certainly be delayed because the stations to be rehabilitated in 1993 would have to be designed in 1992. Finally, the number of station modernizations (or reconstructions) to be undertaken during the proposed third Capital Program has been reduced from 11 to five.

As a result of these changes, the number of stations the TA can begin work on by 1996 may be as few as 140, rather than the 213 projected. Nor should it be forgotten that to reach even this number the TA will have to manage its station programs far more effectively than it has proven itself capable of doing thus far.

Proposed 1992-96 Capital Program

The proposed 1992-96 Capital Program contains planned commitments of nearly \$1.7 billion for stations. The largest planned expenditures are for Station Rehabilitation and Fare Control Modernization at \$693 million and \$556 million, respectively. The proposed plan also includes \$146 million to reconstruct three "flagship" stations: Main Street in Flushing, 149th Street and 3rd Avenue in the Bronx, and the Atlantic Avenue Complex in Brooklyn. In addition, the 1992-96 proposal also includes \$28.5 million for elderly and handicapped access, including the three reconstructed stations, \$96.7 million for public address and signage systems, \$37.7 million for intermodal facilities, and \$126.6 million for replacing overage escalators and elevators.

TRACK

The TA's more than 700 miles of mainline track experienced the same neglect as its stations during the 1970s. From 1972 to 1981, \$158 million was spent on track repair and replacement. This was just a fraction of the amount needed for the routine replacement of worn track. As a result, when the first Capital Program began, less than one-third of all TA track was in a state of good repair.

The 1982-86 Capital Program for track originally set planned commitments at \$365 million. Following a rash of derailments in 1983, the TA was forced to conduct an emergency inspection of all track. That inspection determined that the tracks were in such poor shape in many areas that it was dangerous to ride over them at normal operating speeds. More than 500 emergency slow speed orders were posted, and on-time performance dropped precipitously.

In 1984, the TA conducted its first comprehensive track condition survey, which found such appalling conditions that it increased planned commitments for track to \$591.8 million. The following year the TA announced its new five-year track program goals. It had tripled the number of miles of track to be rehabilitated, doubled the number of locations where switches were to be rehabilitated, and added 20 crossovers to the program.

Although the 1982-86 track program's goals were expanded dramatically, the TA was able to achieve them in most instances. However, the TA fell short of its goals for installing welded rail and rehabilitating switches (see Table 24).

TABLE 24: 1982-86 TA Track Program Performance

| Type of Work | 1981 Goal | 1985 Goal | 1982-1986 Actual | Percent of 1985 Goal Actually Achieved |
|-----------------------------------|--------------|--------------|---------------------|---|
| Track Rehabilitation (miles) | 50 | 151 | 211 | 139.7 |
| Switch Rehabilitation (locations) | 140 | 320 | 205 | 64.1 |
| Welded Rail (miles) | 100 | 60 | 31 | 51.7 |
| Contact Rail Replacement (miles) | 20 | 21 | 23 | 109.5 |
| New Crossovers (locations) | 0 | 20 | 20 | 100.0 |

Source: September 1981 Capital Plan; March 1985 and December 1990 Proposed Capital Plan Amendments

While the 1987-91 track program was more ambitious than the 1982-86 one, it appears that it is generally on or ahead of schedule (see Table 25). Track and Structures met or exceeded its 1987 goals in all areas except welded rail. We were told that the welded rail program is slightly behind schedule because a rail welding machine was out of service for part of 1990.

TABLE 25: 1987-91 Track Program Performance

| Type of Work | 1987-1991 Goal | 1987-1990 Actual | 1991 Projected | 1987-91 Actual/ Projected | Percent of 1987-91 Plan |
|-----------------------------------|-------------------|---------------------|-------------------|---------------------------------|-------------------------------|
| Track Rehabilitation (miles) | 221 | 204 | 33 | 237 | 107.2 |
| Switch Rehabilitation (locations) | 351 | 324 | 58 | 382 | 108.8 |
| Welded Rail Replacement (miles) | 125 | 92 | 15 | 107 | 85.6 |
| Contact Rail Replacement (miles) | 27 | 74 | 14 | 88 | 325.9 |
| New Crossovers (locations) | 2 | 4 | 0 | 4 | 200.0 |

Source: March 1987 Capital Plan; December 1990 Proposed Capital Plan Amendment

Anticipated 1987-91 commitments for track now exceed the 1987 program by \$78.1 million, about 11 percent. This variance, as shown in Table 26, is primarily due to increases in planned commitments for mainline track rehabilitation and switches.

TABLE 26: 1987-91 Track Program
(\$ in millions)

| Element | Planned Commitments | | Change | |
|-----------------------------|---------------------|-----------------|----------------|-------------|
| | 3/87 | 12/90 | Amount | Percent |
| Rehabilitate Mainline Track | \$ 547.4 | \$ 621.4 | \$ 74.0 | 13.5 |
| Modernize Switches | 24.5 | 43.5 | 19.0 | 77.6 |
| Welded Rail | 85.0 | 66.2 | -18.8 | -22.1 |
| Rubber Rail Seats | 1.9 | 0.0 | -1.9 | -100.0 |
| Replace Contact Rail | 30.2 | 36.7 | 6.5 | 21.5 |
| Install Crossovers | <u>13.4</u> | <u>12.5</u> | <u>-0.9</u> | <u>-6.7</u> |
| Total* | <u>\$ 702.4</u> | <u>\$ 780.3</u> | <u>\$ 78.1</u> | <u>11.1</u> |

* May not add due to rounding.

Source: March 1987 Capital Plan; December 1990 Proposed Capital Plan Amendment

The increase in commitments above the amount planned was principally due to greater than anticipated costs for the Lexington Avenue Line, Bronx Concourse Line, and Astoria Line contracts.

In March 1991 the TA reported that between 1982 and the beginning of 1991 it had accomplished the following:

| | |
|--------------------------|---------------|
| Track Rehabilitation | 450 miles |
| Switch Rehabilitation | 590 locations |
| Welded Rail Installation | 139 miles |
| Contact Rail Replacement | 111 miles |
| Crossover Installation | 24 miles |


By doing so, the TA's 648 miles of primary mainline track reached a state of good repair in January 1991. To maintain this condition, the TA must replace 87 miles of track between 1992 and 1996.

Track and Structures Department management believes that the TA's mainline switches will reach a state of good repair in 1997. To achieve this goal, the TA will have to replace 260 switches between 1992 and 1996. Track and Structures replaced 205 switches between 1982 and 1986, and 382 switches between 1987 and 1991, so we believe the goal is realistic if funding is available. Yard switches will not reach a state of good repair in the foreseeable future.

The proposed 1992-96 Capital Program includes \$585.7 million to replace 87 miles of track and 260 mainline switches. It also proposes to install new crossovers on two lines. All work is expected to be performed by TA employees and includes complete track bed reconstruction.

LINE EQUIPMENT

TA line equipment consists of 415 track miles of tunnel lighting, 199 tunnel ventilation fans, 287 pump rooms, 366 circuit breaker houses, and 520 miles of cable.



Nevertheless, the TA's line equipment is further from being in a state of good repair than any other system except signals. When the Capital Program started in 1982, more than 75 percent of the TA's tunnel lights, pumps, and fans were more than 40 years old. TA management does not expect these systems to reach a state of good repair until early in the 21st century.

While the TA has had some success in restoring its pumping equipment to a state of good repair, its tunnel lighting and ventilation fan programs are behind schedule. This is especially true of the fan program. In addition, both programs have experienced delays due to design problems and cost escalation because of unrealistic initial estimates of construction, TA labor, and construction administration costs. Overall, planned 1987-91 commitments for line equipment jumped from \$355 million in March 1987 to \$449 million in April 1991.

The Lexington Avenue Line contract is responsible for more than one-third of this \$93.4 million increase in planned commitments. The March 1987 Capital Plan contained \$177 million for this project, including \$65.5 million in line equipment costs. The TA was forced to add \$64 million to the cost of the project when it turned out to be more expensive than envisioned. The line equipment portion of the contract came in at \$97.1 million, \$31.6 million (48.2 percent) higher than expected. Since that time, the expected cost of line equipment work has increased to \$112.3 million, 23.2 percent more than the estimate when the contract was signed, and 71.5 percent more than the initial budget estimate.

In addition, we found significant omissions in the planning of the fan and lighting programs. While the fan program was in existence before the Capital Program began, the TA did not attempt to determine its ventilation needs or develop an overall fan strategy until 1991 (see page 53). The tunnel lighting design used by the TA also showed an absence of proper planning. The MTA's independent engineer has stated that the design is obsolete and that the decision to use it would have been more appropriate if made during the 1950s.

Tunnel Lighting

Bringing tunnel lighting to a state of good repair has been slower and more costly than envisioned. In addition, O'Brien-Kreitzberg, the MTA's independent engineer, has criticized the TA for using mercury vapor lights, which it has stated are obsolete, in the lighting replacement program.

The TA planned to replace 30 route miles of tunnel lighting during the 1982-86 Capital Program for approximately \$25 million. Just seven miles were replaced for \$12.1 million. On average, each route mile of replacement lighting cost twice as much as expected (See Table 28).

TABLE 28: 1982-91 Tunnel Lighting Replacement Program
(\$ in millions)

| Period | Commitments | | | Route Miles Replaced | | |
|---------|-------------|----------------------|--------------------|----------------------|----------------------|--------------------|
| | Planned | 12/90 Projections | Percent of Plan | 3/87 Plan | 12/90 Projections | Percent of Plan |
| 1982-86 | \$ 25.0 | \$ 12.1 | -48.4 | 30 | 7 | 23.3 |
| 1987-91 | 94.7 | 161.2 | 170.2 | 38 | 35* | 92.1 |

* Includes 24 miles planned for 1991

Source: MTA Capital Plans: September 1981, March 1987, and December 1990
Proposed Capital Plan Amendment

As of December 1990, the TA expected to replace 35 route miles of tunnel lighting, approximately 92 percent of the 1987 goal, under contracts awarded between 1987 and 1991. However, from 1987 to 1990 the TA committed funds to replace only 11 route miles of lighting. To achieve its target it will now have to commit funds to replace 24 miles of tunnel lighting in 1991, more than twice the amount done during the preceding four years.

For the TA to achieve its 1987-91 lighting replacement target, it will have to pay at least \$66.4 million more than expected. As Table 29 shows, this growth in tunnel lighting costs was caused by increases in the amounts earmarked for specific projects and the addition of four projects to the program. To a large extent these increases in planned commitments for existing projects reflect low budget estimates, particularly for the Lexington Avenue Line contract, design problems, and increased TA labor and construction administration costs.

TABLE 29: 1987-91 Lighting Replacement Projects
(\$ in millions)

| Project | Planned Commitments | | 1987-91 Increase | |
|--|-----------------------|------------------------|-----------------------|--------------------|
| | 3/87 | 12/90 | Amount | Percent |
| Flatbush Ave. to Nostrand Junction | \$5.5 | \$8.4 | \$2.9 | 52.7 |
| 33rd to 138th Streets (Lexington Line) | 13.3 | 23.2 | 9.9 | 74.4 |
| Manhattan Bridge to Pacific Street | 7.4 | 12.6 | 5.2 | 70.3 |
| 8th Avenue to Graham Avenue | 7.6 | 29.0 | 21.4 | 281.6 |
| 155th to 205th Streets | 11.0 | 38.4 | 27.4 | 249.1 |
| Pacific Street to 95th Street | 22.2 | 1.4 | -20.8 | 93.7 |
| 8th Avenue Line - 125th to 145th Street* | 16.3 | 21.3 | 5.0 | 30.7 |
| 34th Street to Queens Plaza | 11.5 | 0.0 | -11.6 | -100.0 |
| Whitehall Street to Lexington Avenue | 0.0 | 1.5 | 1.5 | — |
| DeKalb Avenue to Whitehall Street | 0.0 | 16.7 | 16.7 | — |
| South Ferry to Lexington Avenue | 0.0 | 1.1 | 1.1 | — |
| Montague Street Tunnel | <u>0.0</u> | <u>7.6</u> | <u>7.6</u> | <u>—</u> |
| TOTAL | \$ <u>94.8</u> | \$ <u>161.2</u> | \$ <u>66.4</u> | <u>70.0</u> |

* Totals may not add due to rounding

Source: March 1987 Capital Plan; December 1990 Proposed Capital Plan Amendment

Besides the Tunnel Lighting Program being over budget and behind schedule, O'Brien-Kreitzberg reported that the TA's design is obsolete. Moreover, the TA plans to replace the existing incandescent lighting fixtures with mercury vapor fixtures using a bare lamp and no diffuser on a one-for-one basis. Although the luminous output of the mercury vapor fixtures is three times that of the existing fixtures, the TA performed no tests to determine whether the amount of light provided is enough or too much.

Indeed, there are indications that the proposed lighting may be too bright. O'Brien-Kreitzberg noted that bare mercury vapor lamps with no diffusers, at the same spacing and mounting height as the existing lights, create a series of extremely bright point sources with a strong glare for the operators of passing trains. Therefore, visors are proposed for the front of each fixture to reduce glare, but these will also reduce the amount of light provided.

TA specifications call for lamps developed especially for the TA even though they have no special features (the TA refers to these lamps only by a manufacturer's designation). Consequently, it will be difficult for contractors to provide "approved equals," so the TA will have to pay a premium.

Finally, O'Brien-Kreitzberg believes that the fixtures the TA plans to use on future lighting replacement projects, and which it has used on lighting replacement projects to date, are obsolete.

...(T)he decision to use mercury vapor luminaries for the tunnel lighting would have been more appropriate if made in the 1950's, but, due to advances in lighting systems today, mercury vapor is considered by the lighting industry (the Illuminating Engineering Society (IES) and lamp and fixture vendors) to be an obsolete form of lighting and inappropriate as a replacement for the existing tunnel lighting. Due to the current decline in use of mercury vapor, long-term availability for replacement bulbs could be an issue.

These concerns should be addressed before additional funds are committed for lighting replacement. The TA must determine how much light is needed in its tunnels and design a system to provide that much light. In preparing the design, management should take into account the effect of excessive glare on train operators. Finally, alternatives to mercury vapor lighting should be explored.

Pumping Equipment

The 1982-86 Capital Program exceeded its goal of bringing 23 pump plants to a state of good repair, for \$17.4 million more than anticipated. The 1987-91 Pump Program also cost more than estimated. A \$17.3 million increase in planned 1987-1991 commitments was due to significant increases in two projects, the pump replacement component of the Lexington Avenue Line contract and the rehabilitation of six pumping facilities on the Canarsie Line.

TABLE 30: 1982-91 Pump Plant Replacement Program
(\$ in millions)

| Period | Commitments | | | Pumps Replaced | | |
|---------|-------------|---------|--------------------|----------------|-----------------|--------------------|
| | Planned | Actual | Percent Difference | Planned | 4/91 Projection | Percent Difference |
| 1982-86 | \$ 15.0 | \$ 32.4 | 116.0 | 23 | 26 | 13.0 |
| 1987-91 | 77.3 | 94.6 | 22.4 | 45 | 53* | 17.8 |

* Includes 24 pumps planned to be rehabilitated in 1991.

Source: September 1981 and March 1987 Capital Plans and April 1991 Capital Plan Revision

The April 1991 Proposed Capital Plan Amendment states that the TA will exceed its 1987 goal of replacing 45 pump plants during the 1987-91 program by replacing 53 pump plants. It appears the TA will come close to achieving that goal. The TA awarded contracts to rehabilitate 28 pump plants from 1987 to 1990, and in April 1991 expected to award contracts for 25 more pump plants during 1991. As Table 31 shows, as of May 1991, the TA still expected to award contracts for 23 of these 25 pump plants by the end of 1991. The Adams Street/Rockwell Place pumps had been planned as an additional work order to an existing contract, but will have to be competitively bid.

TABLE 31: Pump Contracts Originally Scheduled for 1991 Award

| <u>Contract Number</u> | <u>Pump Locations</u> | <u>Number of Pump Rooms</u> | <u>Estimated Award Date as of 5/91</u> |
|------------------------|-----------------------|-----------------------------|--|
| E31080-3 | Concourse Line | 3 | 8-91 |
| E31233-4 | Cranberry Street Tube | 4 | 10-91 |
| E31027 | Canarsie Line | 6 | 9-91 |
| E31056 | Harlem River | 10 | 6-91 |
| E31076-1 | Adams St./Rockwell Pl | 2 | N/A |
| TOTAL | | 25 | |

Source: TA Project Status Reports, May 1991

The proposed 1992-96 Capital Program includes plans to rehabilitate 70 pump plant and indicates that the TA's pump facilities will reach a state of good repair by 2001 (see Table 32).

TABLE 32: Adherence to February 1990 Pump Plant Replacement Schedule

| <u>Period</u> | <u>TA Schedule for Achieving a State Good Repair as of February 1990</u> | | | <u>Projected Schedule As of April 1991</u> | | |
|---------------|--|-------------------|-------------------|--|-------------------|-------------------|
| | <u>Number</u> | <u>Cumulative</u> | <u>Cumulative</u> | <u>Number</u> | <u>Cumulative</u> | <u>Cumulative</u> |
| | | <u>Number</u> | <u>Percent</u> | | <u>Number</u> | <u>Percent</u> |
| Pre-1982 | 100 | 100 | 34.8 | 100 | 100 | 38.4 |
| 1982-86 | 28 | 128 | 45.0 | 26 | 126 | 43.9 |
| 1987-91 | 56 | 184 | 64.1 | 53 | 179 | 62.4 |
| 1992-96 | 74 | 258 | 89.9 | 70 | 249 | 86.8 |
| Post-1996 | 29 | 287 | 100.0 | 38 | 287 | 100.0 |

Source: February 1990 Needs Assessment and April 1991 Capital Plan with Award Dates Updated to May 1991.

Power Distribution Facilities

While some power distribution projects have been contracted out, most are done by the Track and Structures Department as part of the in-house track program. As of April 1991, the TA expected the 1987-91 Power Distribution Program to cost \$63.8 million, about 39 percent more than anticipated in 1987 (see Table 33).

TABLE 33: 1982-91 Power Distribution Rehabilitation Program
(\$ in millions)

| Period | Planned | Commitments | | |
|---------|---------|----------------------|----------|---------|
| | | Actual/ Projected | Increase | |
| | | | Amount | Percent |
| 1982-86 | \$ 16.0 | \$ 17.5 | \$ 1.5 | 9.4 |
| 1987-91 | 45.9 | 63.8 | 17.9 | 39.0 |

Source: September 1981 and March 1981 Capital Plans; April 1991 Capital Plan Amendment.

Most of this increase is due to the greater than expected cost of the Lexington Avenue Line contract. In general, though, these projects cost considerably more than anticipated (see Table 34).

TABLE 34: 1987-91 Power Distribution Projects
(\$ in millions)

| Project | Commitments | | Change | |
|------------------------|----------------|----------------|----------------|-------------|
| | 3/87 Plan | 12/90 Plan | Amount | Percent |
| Lexington Avenue Line | \$ 10.7 | \$ 24.1 | \$ 13.4 | 125.2 |
| 8th Avenue Line | 19.9 | 23.2 | 3.3 | 16.6 |
| New Lots Line | 7.3 | 8.7 | 1.4 | 19.2 |
| White Plains Road Line | 2.4 | 0.0 | -2.4 | -100.0 |
| Concourse Line | 5.7 | 7.8 | 2.1 | 36.8 |
| TOTAL | \$ 46.0 | \$ 63.8 | \$ 17.8 | 38.7 |

Source: March 1987 Capital Plan; December 1990 Proposed Capital Plan Amendment

Tunnel Fans

The TA has had little success in restoring its 199 fan plants to a state of good repair. The February 1990 twenty-year needs assessment states that when the first Capital Program began, just four fan plants were in good shape. The September 1981 Capital Plan called for the repair or replacement of 25 plants between 1982 and 1986, and in 1984 the TA stated that all fan plants would reach a state of good repair at a cost \$176 million by 1993. The Fan Program encountered quality control and design problems and, as Table 35 shows, the TA replaced just eight fan plants between 1982 and 1986.

TABLE 35: 1982-91 Fan Plant Replacement Program Performance
(\$ in millions)

| Period | Commitments | | | Fan Plants | | |
|---------|-------------|---------|------------|------------|--------|------------|
| | Planned | Actual | Pct. Diff. | Planned | Actual | Pct. Diff. |
| 1982-86 | \$ 41.0 | \$ 44.3 | 7.8 | 25 | 8 | -68.0 |
| 1987-91 | 137.9 | 129.8 | -5.0 | 33 | 24 | -27.3 |

Source: September 1981 Capital Plan, March 1987 Capital Plan, April 1991 Capital Plan

The March 1987 plan included the rehabilitation of 33 fan chambers between 1987 and 1991, but just five of these fan plants -- those being replaced as part of the Lexington Avenue Line Project -- will actually be operational by the end of 1991. The TA expects to award five contracts to replace 19 fan plants during 1991. If the TA awards these five contracts on schedule, it will have awarded six contracts to replace 24 fan plants during the 1987-91 Capital Program, nine less than the 1987 plan called for (see Table 36). Each of these contracts is scheduled to be awarded during the last quarter of 1991.

TABLE 36: Status of 1987-91 Fan Projects

| <u>Fan Plant Location</u> | <u>Number of Fan Plants</u> | <u>Projected/Actual Contract Award</u> | <u>Projected Substantial Completion</u> |
|---------------------------|-----------------------------|--|---|
| Lexington Line | 5 | 12-87 | 9-91 |
| Nassau Loop | 6 | 12-91 | 11-94 |
| Cranberry Tube | 4 | 10-91 | 10-94 |
| Queens Boulevard Line | 2 | 12-91 | 6-94 |
| Concourse Line | 3 | 10-91 | 4-94 |
| Flushing Line* | 4 | 11-91 | 11-93 |
| TOTAL | 24 | | |

* Added in 1989 Capital Plan Amendment

Source: March 1987 Capital Plan; March 1991 TA Project Status Reports

The February 1990 Needs Assessment projects that the TA's fan plants will achieve a state of good repair by 2001. This projection was based on the award during the 1987-91 Capital Program of contracts to replace 29 fan chambers, and the award of contracts to replace 89 more fan chambers between 1992 and 1996. By March 1991, the TA expected its fan plants to reach a state of good repair in 2006. Thus, the schedule for achieving good repair slipped 13 years since 1983 (See Table 37).

TABLE 37: Schedule for Restoring Fans to Good Repair

| <u>Date of Projection</u> | <u>Estimate</u> | <u>Slippage</u> |
|---------------------------|-----------------|-----------------|
| 1983 | 1993 | -- |
| 1986 | 2001 | 8 |
| 1990 | 2001 | 8 |
| 1991 | 2006 | 13 |

Source: TA Needs Assessments

We do not have confidence in the current projection. During the 1982-86 Capital Program, the TA rehabilitated just eight fan chambers; during the 1987-91 Capital Program it rehabilitated just five. Thus, we are skeptical of the TA's plan to replace 51 fan chambers and complete 22 more between 1992 and 1996.

Finally, even if the TA awards contracts for each fan plant included in the program it will not actually reach a state of good repair within the time frame specified. The dates shown in the 1991 Plan Amendment do not represent the completion of work on the fans listed. They represent the commencement of work. Thus, as Table 36 demonstrates, while the TA intends to award contracts to replace 19 fans during 1991, these fans will not actually be operational until 1993 or 1994.

LINE STRUCTURES

The TA has approximately 70 route miles of elevated structures on 16 lines. Most of these structures are steel and are subject to the stress of train movements and exposure to weather. Moreover, they have been neglected; between 1972 and 1981, the TA spent less than \$80 million on their maintenance, far too little to maintain them properly. By the late 1970s new structural defects were outpacing repairs, and between July 1979 and April 1982 the TA repaired just 62 percent of the defects discovered. By June 1982, the defect backlog stood at 456, more than a year's worth of reported defects.

In addition to the 70 route miles of elevated structures, the TA has approximately 23 miles of at-grade and open cut structures, and 137 miles of subway structures. Problems with water intrusion into the subway have occurred in Brooklyn and Manhattan where the ground water table has risen. This has begun to wash away the soil supporting some underground tunnels, thus threatening their structural integrity. Correcting this serious problem is the focus of the Capital Program for underground subway structures.

The line structures budget category is comprised of four elements: remedy water conditions; rehabilitate elevated structures; replace discharge, fire, and water lines; and replace wooden platforms. The TA committed \$201 million for these projects during the 1982-86 Capital Program and accomplished the following:

| | |
|--|----|
| Miles of Subway Structure Rehabilitated | 13 |
| Miles of Elevated Structure Rehabilitated | 8 |
| Locations Where Water Conditions Were Remedied | 6 |

The 1987-91 Capital Program called for commitments of \$454.6 million, more than double those of the 1982-86 program. The TA currently expects to commit \$406.3 million. This drop in planned line structure commitments is primarily attributable to a \$81.4 million decrease in funds for structural repairs (see Table 38).

**TABLE 38: Changes in 1987-91 Capital Plan for Line Structures
(\$ in millions)**

| <u>Project</u> | <u>Planned Commitments</u> | | <u>Change</u> | |
|--|----------------------------|--------------|---------------|----------------|
| | <u>3/87</u> | <u>12/90</u> | <u>Amount</u> | <u>Percent</u> |
| Remedy Water Conditions | \$ 87.3 | \$ 126.5 | \$39.2 | 44.9 |
| Rehabilitate Structures | 357.1 | 275.7 | -81.4 | -22.8 |
| Replace Discharge, Fire, and Water Lines | 1.4 | 4.1 | -2.7 | -192.9 |
| Replace Wooden Platforms | 8.8 | 0.0 | -8.8 | -100.0 |
| Total* | \$ 454.6 | \$ 406.3 | -\$ 48.3 | -10.6 |

* May not add due to rounding.

Source: March 1987 Capital Plan and December 1990 Proposed Capital Program Amendment

A significant portion of this funding shift resulted from a decision in 1988 to defer the \$94 million reconstruction of the Lenox Avenue subway structure in favor of a project to relieve water infiltration. The TA acknowledged, though, that a complete rehabilitation of the Lenox Line from 110th to 117th Streets may be necessary if the water infiltration remedy project proves ineffective.

Other major changes include the deferral of the planned \$43 million rehabilitation of the White Plains Road Line in favor of a project to survey and perform emergency repairs to the Brighton Line. Both this \$34 million project, and a \$10 million project added to reconstruct the Nevins Street Station mezzanine, resulted from unforeseen structural problems. Emergency repairs to the Stillwell Terminal and repairs to the Jerome Avenue Line were also deferred.

TABLE 39: 1987 Plan Versus Actual Structural Repairs

| | <u>Goal As</u> | <u>1987-90</u> | <u>1991</u> | <u>1987-91</u> | <u>Percent</u> |
|--|----------------|----------------|-------------|-----------------|-------------------|
| | <u>of 3/87</u> | <u>Actual</u> | <u>Goal</u> | <u>Estimate</u> | <u>Difference</u> |
| Miles of Subway Structure Rehabilitated | 20 | 21 | 2 | 23 | 15.0 |
| Miles of Elevated Structure Rehabilitated | 25 | 10 | 17 | 37 | 48.0 |
| Miles of At-Grade and Open Cut Structure Rehabilitated | 20 | 2 | 0 | 2 | -90.0 |
| Water Remedy Locations | 8 | 6 | 2 | 8 | 0.0 |

Source: March 1987 Capital Plan; December 1990 Proposed Plan Amendment

Despite these unforeseen problems, and the changes required to address them, the TA expects to meet or exceed the line structure goals set in 1987 except for the rehabilitation of open-cut structures.

The TA anticipates that by the end of 1991, approximately 40 of its 70 miles of elevated structure will be in good repair, and that 123 of 137 miles of underground structure will be in good repair.

SIGNALS AND COMMUNICATIONS

The TA's signal system regulates all train movements and covers more than 740 miles of track. It is composed of approximately 10,700 wayside signals, 9,800 automatic train stops, 2,400 switches, and 124,000 relays. As of 1981, 43 percent of the TA's signal equipment was beyond its normal 50-year replacement age. This equipment is critical to the safety, reliability, and efficiency of train operations. Restoring it to a state of good repair is thus an important Capital Program goal.

The TA communications system consists of telephone, radio, and related systems. The Electrical Department has identified a number of problems involving the existing communications system. First, much of the system is past its 40-year normal replacement age and parts of the cable network have deteriorated due to electrolysis. Second, the cable network is antiquated and incapable of accommodating planned data transmission expansion. Third, the TA leases its cables and switching equipment from AT&T and New York Telephone, which is expensive.

Signal Equipment

The largest component of the Capital Program for signals and communications calls for replacing all signal equipment and enclosures with modern equipment. Once that is accomplished, the TA will attempt to achieve a rational replacement cycle. The TA cites four benefits from signal modernization:

- improved reliability and decreased maintenance costs;
- reduced personnel requirements due to the consolidation of more than 200 signal towers into 30 strategically placed master towers and centralized control of equipment;
- reduced power costs due to the replacement of signals operating from sources of 25 Hz power (which is supplied to the TA at a premium cost) with signals that operate on standard 60 Hz power; and
- increased train speeds, improved train coordination, and decreased headways which improve the TA's capacity to transport passengers.

During the first two Capital Programs, \$634 million was committed for signal modernization. The TA replaced signal equipment and enclosures over 136 track miles, or 18 percent of the 740-mile signal system (see Table 40).

TABLE 40: TA Capital Program for Signals, 1982-91
(\$ in millions)

| Period | <u>Signal Equipment</u> | | <u>Signal Enclosures</u> | |
|---------|----------------------------------|--|----------------------------------|--|
| | <u>Funds</u> <u>Committed</u> | <u>Number of</u> <u>Track Miles</u> | <u>Funds</u> <u>Committed</u> | <u>Number of</u> <u>Track Miles</u> |
| 1982-86 | \$ 237.5 | 73 | \$ 32.0 | 87 |
| 1987-91 | 333.1 | 63 | 31.6 | 40 |

Source: December 1990 Proposed Capital Plan Amendment

Despite these accomplishments, the TA committed fewer funds to signal modernization programs than intended in each Capital Program, as shown in Table 41:

TABLE 41: 1982-91 Planned and Actual Commitments
(\$ in millions)

| Period | <u>Original</u> <u>Budget</u> | <u>Actual</u> <u>Commitments</u> | <u>Change</u> | |
|---------|----------------------------------|-------------------------------------|---------------|----------------|
| | | | <u>Amount</u> | <u>Percent</u> |
| 1982-86 | \$ 412.0 | \$ 305.5 | -\$ 106.5 | -25.8 |
| 1987-91 | 536.1 | 364.7 | -171.4 | -32.0 |

Source: September 1981 Capital Plan, December 1990 Proposed Plan Amendment

According to the Director of Strategic Planning for the Division of Electrical Systems, the TA deferred five signal modernization projects to use the funds on higher priority non-signal projects whose cost exceeded original estimates. Deferring these five projects decreased the track miles that the TA was able to commit to the signal modernization program in the two five-year periods, as shown in Table 42.

TABLE 42: Planned and Actual Signal Improvements, 1982-91

| | <u>Number of Track Miles</u> | |
|--------------------------------|------------------------------|-------------------|
| | <u>Signal</u> | <u>Signal</u> |
| | <u>Equipment</u> | <u>Enclosures</u> |
| 1982-86: | | |
| Originally Scheduled | 87 | 87 |
| Actually Committed | <u>73</u> | <u>87</u> |
| Number of Track Miles Deferred | <u>14</u> | <u>0</u> |
| Percent Deferred | 16.1 | 0.0 |
| 1987-91: | | |
| Originally Scheduled | 75 | 78 |
| Actually Committed | <u>63</u> | <u>40</u> |
| Number of Track Miles Deferred | <u>12</u> | <u>38</u> |
| Percent Deferred | 16.0 | 48.7 |

Source: Strategic Plan 1991, TA Division of Electrical Systems

By deferring signal modernization projects to future periods, the TA slowed the modernization of its antiquated signals. This will delay the attainment of a state of good repair until at least the year 2012.

Communications Equipment

The communications program has two main components. The first is the replacement of outdated telephone cables and switching equipment with modern TA-owned equipment. This will improve service, decrease operating costs, and permit the expansion of the TA's data transmission capacity. The cornerstone of the telephone modernization program is the installation of a new fiber optic system which will serve as the trunk or "express" lines in the telephone system.

The second main component is the upgrading of the radio antenna which permits radio communication between trains and the Rapid Transit Operations Department (RTO) command center, and which is also used by the Transit Police Department. This system consists of 198 miles of antenna cable, linked to radio base stations. The goal of this program is to eliminate radio "dead spots," which exist in tunnels and on bridges.

TA plans to replace the telephone cables it leases from New York Telephone were also affected by project deferrals (see Table 43).

TABLE 43: Telephone Cable Installation Deferrals
(\$ in millions)

| | <u>Amount Committed</u> | <u>Number of Projects</u> | <u>Number of Route Miles</u> |
|---|-----------------------------|-------------------------------|----------------------------------|
| <u>1982-86:</u> | | | |
| Plan | \$26.4 | 6 | 46 |
| Actual | <u>14.8</u> | <u>3</u> | <u>25</u> |
| Amount Deferred | <u>\$11.6</u> | <u>3</u> | <u>21</u> |
| Percent Deferred | 43.9 | | 45.7 |
| <u>1987-91:</u> | | | |
| Plan | \$52.1 | 17 | 103 |
| Actual | <u>49.1</u> | <u>14</u> | <u>91</u> |
| Amount Deferred | <u>\$3.0</u> | <u>3</u> | <u>12</u> |
| Percent Deferred | <u>5.8</u> | <u>17.6</u> | <u>11.7</u> |
| Source: December 1990 Proposed Capital Plan Amendment; Strategic Plan 1991, TA Division of Electrical Systems | | | |

The decrease in expenditures for telephone cable was more than offset by huge increases in the cost of the new fiber optic and telephone switching systems. The actual cost for both of these programs greatly exceeded the TA's original estimates (see Table 44).

TABLE 44: Fiber Optic Cost Escalation
(\$ in millions)

| | <u>Original Estimate (1987)</u> | <u>Actual Commitments (1991)</u> | <u>Change</u> | |
|---|---|--|----------------|----------------|
| | | | <u>Amount</u> | <u>Percent</u> |
| Fiber Optic System | \$ 38.9 | \$ 97.0 | \$ 58.1 | 149 |
| Telephone System (Switches & Sets) | 23.5 | 32.7 | 9.2 | 39 |
| Fiber Optic/Telephone Interface Equipment | <u>0.0</u> | <u>22.9</u> | <u>22.9</u> | <u>--</u> |
| Total | <u>\$ 62.4</u> | <u>\$ 152.6</u> | <u>\$ 90.2</u> | <u>145</u> |
| Source: March 1987 Capital Plan; December 1990 Proposed Capital Plan Amendment Plan | | | | |

According to the Division of Electrical System's Director of Strategic Planning, changes in the scope of the fiber optic project were partially responsible for its increased cost. When the project was originally planned in 1987, the fiber optic network was to replace 100 route miles of copper cable in the TA's telephone system. In 1988, however, the TA added 270 route miles of fiber cable installation to accommodate the new supervisory control and data acquisition (SCADA) network planned for the TA's power system.

The Director also said that the TA significantly underestimated the cost of purchasing and installing both the fiber optic cable and the new telephone switches and headsets. The current estimate of the project's cost (\$97 million for fiber cable and \$32.7 million for the telephone system) is still \$44.6 million (52 percent) more than the TA's adjusted estimates for the projects.

Both contracts were awarded in 1989 and are scheduled to be completed before the end of 1992. Until that time, it is difficult to assess whether the anticipated benefits of these high-tech purchases outweigh their increased cost.

Almost 64 miles of antenna cable were replaced during the first two Capital Programs, meeting the TA's goal for this project. The antenna replacement program has also remained within budget.

Progress Toward A State of Good Repair

As of April 1991, 327 track miles of signals, 44 percent of the entire 740 mile signal system, was in a state of good repair. To reach a state of good repair for the remaining 488 track miles by 2012, the TA's current target, the Electrical Department plans to modernize 25 track miles of signal equipment per year. However, this may be an overly optimistic assessment of the TA's capabilities. During the first two Capital Programs, the TA managed to modernize the signals for only 136 track miles, or 13.6 miles annually.

The Electrical Department expects to reach a state of good repair for telephone cable and antenna cable in 2001 and 1996, respectively.

Proposed 1992-96 Capital Program

The proposed 1992-96 Capital Program includes \$771.6 million for three types of signal modernization projects. The first, expected to cost \$522.6 million, involves the same type of signal equipment/enclosure modernization projects performed in the first two Capital Programs. Of this amount, \$424.4 million is for the Pelham, White Plains Road, and Sea Beach Lines, 67 track miles in all. The remaining \$98.2 million is for the 12-mile Brighton Line signal modernization project which was deferred from the 1987-91 Capital Program.

The second type of proposed signal modernization project, expected to cost \$243 million, involves installing "moving block" signal systems on the Canarsie and Flushing Lines. This system is a departure from the standard signal system used by the TA. A moving block system requires little wayside equipment, but additional equipment would have to be added to the car fleet. The advantages of such a system include continuous train identification for automatic routing, lower signal maintenance costs, and a significant reduction in headway between trains.

The third type of proposed signal modernization project, estimated to cost \$6 million, involves improvements to the Broadway-7th Avenue IRT Line to provide better service between 242nd Street and 96th Street. The proposed 1992-96 Capital Program also contains \$93 million for an Automatic Train Supervision System (ATS) on the IRT Division, \$28.8 million for telephone cable replacement, and \$8.7 million to modernize outdoor radio antennas.

POWER

In 1981, the TA had 190 electrical substations which converted alternating (AC) current to direct current (DC) for railroad use. At that time, the TA identified the following problems:

- The equipment at more than half of the TA's substation exceeded its standard 40-year life span and required extensive maintenance to operate normally.
- 28 IRT/BMT substations used manual rotary converters that had to be manned 24 hours a day, seven days a week.
- Most of the substations used mercury arc rectifiers, which were obsolete and required mercury, a toxic substance, to operate.
- Many of substations used 25 Hz input (rather than the standard 60 Hz), which the TA purchased at a surcharge from Con Edison.
- The IRT power system, with long track sections dependent on large multi-unit converters, was vulnerable to power loss and electrolysis.

To address these problems and bring the power system to a state of good repair, the TA Capital Program called for re-equipping IND substations with modern silicon rectifiers and transformers. [REDACTED]

The program also called for the replacement of large IRT substations which feed long sections of track with a greater number of smaller substations supplying power to shorter sections. This would permit rapid detection of faults, and allow the TA to isolate the effects of power failures.

During each of the first two Capital Programs, the TA deferred a significant number of substation modernization projects, as shown in Table 45.

TABLE 45: Deferred Substation Modernization, 1982-91

| | 1982-86 | | | 1987-91 | | |
|--------------------------|-----------|-----------|------------------|-----------|------------------|------------------|
| | Planned | Actual | Percent Deferred | Planned | Actual/Estimated | Percent Deferred |
| Substations Re-Equipped: | | | | | | |
| IRT/BMT | 36 | 21 | 41.7 | 20 | 17 | 15.0 |
| IND | 31 | 19 | 63.2 | 30 | 30 | 0.0 |
| | <u>67</u> | <u>40</u> | <u>40.3</u> | <u>50</u> | <u>47</u> | <u>6.8</u> |
| Enclosures Modernized: | | | | | | |
| IRT/BMT | 26 | 18 | 30.8 | 24 | 15 | 37.5 |

Source: September 1981 and March 1987 Capital Plans; April 1991 Plan Amendment

According to the TA, these projects were deferred for two reason. First, they were deferred to fund higher priority projects whose costs exceeded original estimates. Second, in several cases, the TA faced community opposition to the construction of substations or construction was delayed until necessary city approvals could be obtained.

The deferral of substation modernization has delayed the TA's achievement of a state of good repair for its power system. In November 1983, the TA anticipated that it would bring its power system to a state of good repair by 1993. By March 1986, the TA estimated the IRT and BMT power systems would reach a state of good repair in 1996 and the IND would reach that status by 1999. The February 1990 Needs Assessment projects that a state of good repair will be achieved on all divisions in 1999.

According to the proposed 1992-96 Capital Plan, the TA will commit an additional \$204.6 million to modernize substations and to replace or rehabilitate nine IRT/BMT substation enclosures and one enclosure in the IND system. This program also includes funds for re-equipping 15 IRT/BMT substations and one IND substation with silicon diode rectifiers.

SHOPS

The subway car fleet is inspected and maintained at 13 barns located throughout the system and at two overhaul shops at 207th Street in Manhattan and Coney Island in Brooklyn. In addition, the maintenance of the TA's right-of-way is supported by 18 speciality shops which prefabricate or repair structural elements, track, switches, signals, and other equipment. These shops and barns are critical for the safe and efficient operation of the subway system. At the inception of the 1982-1986 Capital Program, most of the TA's shops and barns were in disrepair.

The 1982-86 Capital Program envisioned the complete modernization of both overhaul shops, all 13 barns, and a number of maintenance-of-way facilities at a cost of \$432 million. In November 1983 it was expected that all maintenance barns and shops would reach a state of good repair by 1986.

However, between 1982 and 1986, planned commitments for shops decreased by \$104.4 million (24 percent) from \$432 million to \$327.6 million (see Table 46). Over half of the money actually spent was used to rehabilitate the Coney Island Shop and Barn, which increased from an estimated \$126 million in 1983 to a final cost of \$192 million. Much of the other work planned for the 1982-86 program was deferred. Four maintenance shops received major rehabilitations and five others received minor ones.

TABLE 46: 1982-86 and 1987-91 Planned and Actual Commitments
(\$ in millions)

| <u>Period</u> | <u>3/87 Plan</u> | <u>12/90 Plan</u> | <u>Change</u> | |
|---------------|----------------------|-----------------------|---------------|----------------|
| | | | <u>Amount</u> | <u>Percent</u> |
| 1982-86 | \$ 432.0 | \$ 327.6 | -\$ 104.4 | -24.2 |
| 1987-91 | 327.9 | 266.9 | - 61.0 | -18.6 |

Source: September 1981 and March 1987 Capital Programs; December 1990 Proposed Capital Plan Amendment

The 1987-91 Capital Program contained almost \$328 million to rehabilitate the 207th Street Overhaul Shop and three maintenance shops and to construct or rehabilitate 11 Track and Structures Department facilities. By December 1990, planned commitments had dropped by \$61 million (19 percent) to \$267 million. This decline was primarily attributable to the deferral of most of the work planned for 207th Street and several Track and Structures shops. These deferrals were partially offset by cost increases on several Division 'B' Barn projects.

TABLE 47: 1987-91 Capital Program Changes
(\$ in millions)

| <u>Capital Program Element</u> | <u>Planned Commitments</u> | | <u>Change</u> | |
|--|----------------------------|-------------------|---------------|----------------|
| | <u>3/87 Plan</u> | <u>12/90 Plan</u> | <u>Amount</u> | <u>Percent</u> |
| Coney Island Shop and Barn | \$ 22.5 | -\$24.4 | -\$ 1.9 | -8.4 |
| 207th Street Shop and Barn | 78.7 | 1.2 | -77.5 | -8.5 |
| Division 'A' Barns | 0.0 | 1.7 | -1.7 | — |
| Division 'B' Barns | 171.3 | 206.8 | -35.5 | -20.7 |
| Track & Structures, Electrical Shop | <u>55.4</u> | <u>32.8</u> | <u>-22.6</u> | <u>-40.8</u> |
| TOTAL | \$327.9 | \$266.9 | \$61.0 | 18.6 |

Source: March 1987 Capital Plan; December 1990 Proposed Capital Plan Amendment

The modernization of the 207th Street Overhaul Shop, originally scheduled to begin in 1989, was deferred for several reasons. First, the TA considered the bids to be too high. Thus, the TA had the project re-bid. Second, delays in completing the Coney Island projects forced the TA to defer starting this project. The TA believed it would be detrimental to subway car maintenance and service to have both overhaul facilities undergoing rehabilitation at the same time. The TA now expects to begin modernization of the Overhaul Shop in 1992 with completion to occur in 1995.

Although planned commitments for Division 'B' Barns grew by 20 percent between 1987 and 1990, the TA will not meet its original goals. Cost increases to the East New York and Jamaica Barns rehabilitations and the Canarsie Chemical Car Washer project more than offset the cancellation of the Pitkin Barn Phase II rehabilitation. Funding to rehabilitate Track and Structures Shops was reduced by \$22.6 million during the 1987-91 program as a number of projects were either deferred or substantially cut (see Table 48).

TABLE 48: Track and Structures Shops Reductions
(\$ in millions)

| <u>Project</u> | <u>Planned Commitments</u> | | <u>Change</u> | |
|--|----------------------------|----------------|-----------------|----------------|
| | <u>3/87</u> | <u>12/90</u> | <u>Amount</u> | <u>Percent</u> |
| Linden Yard Repair Shop | \$ 12.3 | \$ 0.0 | -\$ 12.3 | -100.0 |
| Westchester Yard Repair Shop | 3.9 | 0.0 | -3.9 | -100.0 |
| Linden Power Distribution Storage Facility | 1.1 | 0.0 | -1.1 | -100.0 |
| Linden Power Distribution Welding Shop | 5.0 | 0.0 | -5.0 | -100.0 |
| New A.C. Shop: Pitkin Shop | 2.5 | 0.0 | -2.5 | -100.0 |
| Linden Track Welding Shop | 2.0 | 0.0 | -2.0 | -100.0 |
| Iron Works - Williams Place | 13.0 | 4.2 | -8.8 | -67.7 |
| 38th Street Yard HVAC Shop | 2.5 | 3.2 | 0.7 | 28.0 |
| Linden Boulevard Shop Phase 3 | 5.5 | 8.9 | 3.4 | 61.8 |
| 38th Street Yard Crew Quarters | 5.6 | 11.9 | 6.3 | 112.5 |
| Canarsie Track Quarters | 1.9 | 2.6 | 0.7 | 36.8 |
| Tiffany Shop | 0.1 | 0.0 | -0.1 | -100.0 |
| Signal Shop Rehabilitation | 0.0 | 0.9 | 0.9 | — |
| Other | <u>0.0</u> | <u>1.1</u> | <u>1.1</u> | <u>—</u> |
| TOTAL | \$ 55.4 | \$ 32.8 | -\$ 22.8 | -40.8 |

Source: March 1987 Capital Program; December 1990 Proposed Capital Plan Amendment

By 1992, the Coney Island Overhaul Shop and four of 13 maintenance shops will have achieved a state of good repair. Three additional maintenance shops are expected to reach a state of good repair by the end of the third program. The remaining maintenance shops will not be restored to good repair until after 1996. While not one of the six electrical shops is in a state of good repair, the TA did not rehabilitate any Electrical Department shops during the first two Capital Programs. Five of 12 Track and Structures Shops are not in a state of good repair.

The proposed 1992-96 Capital Program contains \$276.9 million for shops. More than half of all planned commitments are allocated to modernize the 207th Street Overhaul Shop and build a new car washer. The Concourse Maintenance Shop is the only other maintenance facility expected to be addressed during the 1992-96 Capital Program. Contracts to rehabilitate or construct the Special Equipment Repair Shop at Linden, a new Heating, Ventilation, and Air Conditioning Shop at Pitkin, and a new Iron Shop are expected to be awarded. Similarly, contracts to expand two Electrical Department shops at East 180th Street and East New York are expected to be awarded during the 1992-96 Capital Program.

YARDS

The TA's 22 train yards encompass almost 400 acres scattered throughout the subway system. These yards, with approximately 120 miles of track and more than 1,000 switches, house over 6,000 subway cars. They are also used for car storage, inspection, and maintenance.

With few exceptions, the TA has made just minimal investments in its yards. Funds were allocated to rehabilitate train yards during the first two Capital Programs, but some of these funds were diverted to programmatic areas in which additional needs had to be addressed.

During the 1982-86 Capital Program the TA achieved just 56 percent of its planned commitments for yards (see Table 49). This resulted from a decision in 1985 to pursue yard expansions while deferring yard rehabilitations for other capital work. During the 1982-86 program, the only yards that underwent major rehabilitation were the Westchester and Linden Yards.

TABLE 49: 1982-91 Yard Rehabilitation and Expansion Program Performance
(\$ in millions)

| Period | Commitments | | | Yard Rehabilitation Projects | | | Expansion Projects | | |
|---------|-------------|---------|---------|------------------------------|--------|---------|--------------------|--------|---------|
| | Planned | Actual | Percent | Planned | Actual | Percent | Planned | Actual | Percent |
| | | | | | | | | | |
| 1982-86 | \$350.0 | \$194.7 | 55.6 | 6 | 2 | 33.3 | 2 | 6 | 300.0 |
| 1987-91 | 320.9 | 110.8 | 34.5 | 6 | 1 | 16.6 | 4 | 3 | 75.0 |

Source: September 1981 and March 1987 Capital Plans, December 1990 Proposed Capital Plan Amendment.

Planned yard rehabilitation projects were also dropped from the 1987-91 Capital Program. From a planned five-year expenditure of almost \$321 million in 1987, funding for yards declined by almost two-thirds to \$111 million in 1990.

As a result of these cuts, six of ten yard rehabilitation or expansion projects planned in 1987 were eliminated from the Capital Program. The projects that were eliminated are: (1) Coney Island Yard Rehabilitation, (2) East New York Rehabilitation, (3) Canarsie Yard Rehabilitation, (4) 38th Street Yard Rehabilitation, (5) Jamaica Yard Expansion, and (6) East New York Barn tracks. No new expansion or rehabilitation projects were added.

During the 1982-86 and 1987-91 Capital Programs the TA made only minimal investments in its yards, focusing primarily on securing and expanding facilities, rather than restoring them to a state of good repair. It chose instead to afford priority to mainline track, switches, and signals. The Authority justified its underinvestment in yards by citing the greater importance of the mainline infrastructure and the slower speeds at which trains travel in yards. This has allowed the TA to maintain normal operations in its yards even though many of the switches are in poor shape.

Nevertheless, 67 of 120 miles of yard track (56 percent), 825 of 1,025 yard switches (80 percent), and seven of 22 yard signal systems (32 percent) were found to be in need of replacement by the TA's 1988 Mainline Track and Switch Condition Survey. The TA expected its yard track to reach a state of good repair in 2006, its yard switches to reach a state of good repair in 2012, and its yard signals to do so in 2009.

However, these estimates are questionable. The TA plans to rehabilitate two miles of track and 30 switches each year from 1992 to 1996. At that rate, the track in the yards will reach a state of good repair in 2024, and the switches will reach that status in 2018.

The proposed 1992-96 Yard Program is set at \$237 million, more than was actually committed for yard projects during either of the first two Capital Programs. Almost half of this money, \$91 million is earmarked for the Jamaica Yard Expansion Project, which was deferred during the 1987-91 program. Another \$81 million is for track and switch rehabilitation.

DEPOTS

As the first Capital Program began, the TA Surface Department had 22 depots for storing and maintaining 4,560 buses. The average depot was 50 years old, and the oldest was 95 years old. Some depots started out as trolley barns, exposition centers, piers, or warehouses, and were later converted to depots. Eleven depots were too small to house their entire fleets and close to 1,000 buses had to be stored outdoors.

Depots is one of the TA Capital Program's most volatile categories. As Table 50 demonstrates, the TA failed to achieve its objectives during each of the two Capital Programs. The TA now expects to take 15 years to complete a program it originally expected to take ten years. Our review of the proposed 1992-96 program indicates that even this schedule is questionable. Moreover, the total anticipated cost of the depot program has risen from approximately \$440 million in 1982 to \$1.3 billion today.

The 1982-86 Capital Program failed to achieve its goals largely because initial planning was so poor that the entire program had to be revamped in 1985 and again in 1986. As with so many areas, the TA failed to make an adequate assessment of the capital facilities to be addressed. Consequently, more work was required than originally anticipated. This caused delays and added to the cost of the program. In addition, the TA determined after the program was well underway that some of the depots scheduled for the 1987-91 Capital Program were in such bad shape that they required immediate work. Finally, the TA's initial cost estimates were unreasonably low.

These problems continued into the 1987-91 Capital Program, but other problems surfaced as well, not all of which were within the TA's control. The Hudson Pier Depot, for example, was to be replaced as part of the Westway Project. That project was delayed when Westway was eliminated from New York City's Capital Plan and further delayed by the TA's inability to find an alternate site. Constructing the Manhattanville Depot was delayed when the MTA tried to coordinate building the depot with local housing development.

TABLE 50: 1982-91 Depot Programs
(\$ in millions)

| Period | New Construction | | | | | |
|---------|------------------|---------|--------------------|--------------|--------|--------------------|
| | Commitments | | | Depots Built | | |
| | Planned | Actual | Percent Difference | Planned | Actual | Percent Difference |
| 1982-86 | \$ 275.0 | \$ 98.8 | -64.1 | 6* | 2 | -66.7 |
| 1987-91 | 391.5 | 296.7 | -24.2 | 6** | 3 | -50.0 |

| Period | Rehabilitation | | | | | |
|---------|----------------|---------|--------------------|--------------|--------|--------------------|
| | Commitments | | | Depots Built | | |
| | Planned | Actual | Percent Difference | Planned | Actual | Percent Difference |
| 1982-86 | \$ 55.0 | \$ 86.1 | 56.5 | 11 | 6 | -45.5 |
| 1987-91 | 126.1 | 106.4 | -15.6 | 11 | 8*** | -27.3 |

* Includes new Gun Hill Maintenance Shop and East New York Repair Facility.

** Includes two new base shops.

*** Does not include Walnut Depot (on hold pending Coliseum sale), Fresh Pond Depot (design only in 1987-91 program), or Jamaica Depot (emergency repairs).

Source: September 1981 Capital Plan, March 1987 Capital Plan, December 1990 Proposed Capital Plan Amendment

1982-86 Depot Program

The depot program proposed in September 1981 was primarily a new construction program. It included \$275 million to construct four depots and two shops and \$55 million to rehabilitate or modernize 11 other facilities between 1982 and 1986. This work was to be the first phase of a comprehensive ten-year program to restore all depots to a state of good repair (see table 51).

TABLE 51: Ten-Year Bus Depot Plan as of November 1981
(\$ in millions)

| <u>Depot</u> | <u>Year Built</u> | <u>Number of Buses Stored Outdoors</u> | <u>Work To Be Done</u> | <u>Cost</u> | <u>Timing</u> |
|---------------------------------|-----------------------|--|------------------------|-------------|---------------|
| <u>Bronx</u> | | | | | |
| Coliseum | 1900 | 134 | To Be Closed | | |
| West Farms | 1890 | 14 | To Be Closed | | |
| Walnut | 1949 | 0 | Rehabilitate | \$ 13.0 | 1982-86 |
| Gun Hill Depot and Base Shop | | 0 | New Construction | 70.0 | 1982-86 |
| <u>Manhattan</u> | | | | | |
| Kingsbridge | 1897 | 0 | New Construction | 32.0 | 1982-86 |
| Amsterdam | 1947 | 38 | Rehabilitate | 2.6 | 1982-86 |
| 132nd Street | 1918 | 90 | New Construction | 33.4 | 1982-86 |
| 146th Street | 1890 | 0 | Rehabilitate | 2.0 | 1982-86 |
| 126th Street | 1949 | 0 | Rehabilitate | 4.9 | 1982-86 |
| 100th Street | 1895 | 0 | New Construction | 38.0 | 1987-91 |
| 54th Street* | 1909 | 0 | New Construction | 47.5 | 1987-91 |
| Hudson Pier | 1949 | 0 | To Be Replaced | | |
| <u>Brooklyn</u> | | | | | |
| East New York Depot and Shop | 1950 | 0 | Rehabilitate | 18.6 | 1982-86 |
| Fifth Avenue | 1885 | 120 | New Construction | 27.4 | 1982-86 |
| Fresh Pond | 1960 | 0 | Rehabilitate | 1.7 | 1982-86 |
| Flatbush | 1950 | 95 | Rehabilitate | 6.1 | 1982-86 |
| Ulmer Park | 1950 | 75 | Rehabilitate | 6.6 | 1982-86 |
| Crosstown | 1948 | 77 | New Construction | 38.0 | 1987-91 |
| Fanchon Place | | 0 | New Construction | 17.0 | 1982-86 |
| <u>Queens</u> | | | | | |
| Flushing | 1950 | 0 | New Construction | 38.0 | 1987-91 |
| Jamaica | 1940 | 70 | New Construction | 35.0 | 1987-91 |
| Queens Village | 1974 | 0 | Rehabilitate | 0.4 | 1982-86 |
| <u>Staten Island</u> | | | | | |
| Castleton | 1950 | 124 | Rehabilitate | 2.4 | 1982-86 |
| Yukon | | | To open July 1981 | ** | |
| Edgewater | | | Not in 1981 Program | | |

* Originally scheduled to be rehabilitated in 1982 and reconstructed later.

** Previous funding.

Source: November 10, 1981 Capital Program for the TA Surface Department

The 1985 Capital Program Amendment changed the focus of the depot program from new construction to rehabilitation. This change was necessitated by shortcomings in the original 1981 strategy. First, many depots were in much worse shape than TA officials realized. Past underinvestment had taken its toll on the operating environments within the depots and on the structures themselves. The extent of this deterioration was, according to the 1985 amendment, "inadequately assessed in the original plan." Consequently, the money needed for rehabilitation projects was significantly greater than what was available.

Second, the TA's initial cost estimates were extremely low. The TA, for example, had to increase funding for the Gun Hill Depot by \$9 million. It was also forced to shelve its plans to replace the 132nd Street Depot because the bids were much higher than the amount budgeted. Low initial cost estimates also affected the rehabilitation projects. By 1984 it was clear that the funding for the 146th Street, 126th Street, and Amsterdam depots was insufficient to complete even the minimum amount of work needed to keep them functioning properly and \$71.3 million was added to the depot rehabilitation program.

Third, the TA failed to adequately assess the condition of its depots. This caused it to omit the Hudson, 100th Street, Flushing, 54th Street, and Edgewater depots from the 1982-86 program. These depots were, instead, left for the 1987-91 program. However, by 1985 it was clear that they were, in the TA's own words, in "deplorable condition," and had to be rehabilitated or replaced as soon as possible.

Community opposition and other external delays also exacted a toll. Work on the new Gun Hill Depot was delayed while an environmental assessment was done. The Manhattanville Depot, which was to replace the 132nd Street Depot, was delayed 18 months when the Harlem Urban Development Corporation asked the MTA to redesign the project for joint use as a housing project.

To make matters worse, a delay in one project often affected others. The new Kingsbridge Depot could not be started until the Gun Hill Depot was finished because the new Gun Hill Depot was to house the buses that had been stored in the old Kingsbridge Depot. Similarly, the replacement of the 54th Street Depot is dependent on the opening of Manhattanville.

Finally, some work was not adequately coordinated with operating personnel. At East New York, where the depot and the base shop were being rehabilitated, the TA asked the contractor to stop working on the base shop when it became apparent that the project had to be redesigned. When a satisfactory arrangement could not be reached, work was halted and the contract terminated.

As a result of such problems, the TA was forced to make drastic changes to its depots program. New depots planned for 132nd Street, West Side, Kingsbridge, and Jamaica were deferred. Also deferred were plans to construct shops at Gun Hill and Fanchon Place, and Ulmer Park and Flatbush bus enclosures. Added to the 1982-86 program were funds for a new fueling, washing, and maintenance facility at Edgewater and a new maintenance facility on the site of the old Flushing Depot. The program called for new depots at Gun Hill and Fifth Avenue, and the beginning of "staged" new construction at Flushing and Edgewater. All other depots except Kingsbridge and 132nd Street, which were to be rebuilt during the 1987-91 program, would be rehabilitated.

The 1986 program saw further reductions in the construction program as the Gun Hill Base Shop and the Edgewater and Flushing facilities were deferred. Planned new construction commitments dropped to \$103.7 million. Planned rehabilitation commitments dropped from \$192 million to \$126.2 million as work on the Jamaica, Flatbush, Coliseum, 54th Street, and 100th Street depots was deferred until the second Capital Program.

By the end of the 1982-86 Capital Program, the TA had accomplished a good deal less than had been originally planned. The new Fifth Avenue Depot, now known as the Jackie Gleason Depot, had opened and construction was underway at Gun Hill. All other new construction had been cancelled or postponed. In addition, rehabilitation had begun at just six facilities, rather than the 11 planned.

1987-91 Depot Program

The delays and cost increases of the first Capital Program continued into the second Capital Program. The 1987 Capital Program set planned commitments for depots at \$564.7 million. By December 1990 planned commitments had decreased by \$109.6 million, to \$455.2 million due primarily to a reduction in the TA's new construction program. Planned commitments for rehabilitations also dropped, but not as much (see Table 52).

TABLE 52: Depot Plan Changes, 1987-91
(\$ in millions)

| Program Element | 1987 Plan | 1991 Plan | Change | |
|-----------------------|--------------|--------------|----------|---------|
| | | | Amount | Percent |
| Construct New Depots | \$ 391.5 | \$ 296.7 | -\$ 94.8 | -24.2 |
| Rehabilitate Depots | 126.1 | 106.4 | -19.7 | -15.6 |
| New Radio System | 40.7 | 51.3 | 10.6 | 26.0 |
| Equipment & Machinery | 6.4 | .7 | -5.7 | -89.1 |
| TOTAL | \$ 564.7 | \$ 455.2 | -\$109.6 | -19.4 |

Source: March 1987 Capital Plan, December 1990 Proposed Capital Plan Amendment

New Bus Depots. The 1987 Capital Plan contained \$391.5 million for four new bus depots (Hudson Pier/West Side, Kingsbridge, Flushing, and Manhattanville) and two new base (i.e., central repair) shops (see Table 53). The shifts in construction plans which marred the 1982-86 Capital Program continued into the second Capital Program as well. By 1991, it was clear that just three of the six facilities the TA planned to build in 1987 would be built during the second Capital Program.

TABLE 53: Planned 1987-91 Construction of New Depots
(\$ in millions)

| <u>Depot</u> | <u>1987</u> <u>Plan</u> | <u>1988</u> <u>Plan</u> | <u>1989</u> <u>Plan</u> | <u>1990</u> <u>Plan</u> | <u>1991</u> <u>Plan</u> |
|--|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| <u>Bronx</u> | | | | | |
| Gun Hill Base Shop | \$ 58.8 | \$ 62.1 | \$ 60.8 | \$ 58.6 | \$ 8.8 |
| <u>Manhattan</u> | | | | | |
| Kingsbridge | 65.9 | 66.5 | 87.0 | 89.9 | 89.9 |
| 132 St/Manhattanville | 87.8 | 104.4 | 107.7 | 105.7 | 104.2 |
| 54th Street (demolition of old depot and site preparation) | 0.0 | 15.5 | 15.3 | 8.0* | 8.0* |
| Hudson Pier/West Side | 60.9 | 62.5 | 67.5 | 36.0 | 20.0 |
| <u>Brooklyn</u> | | | | | |
| Fresh Pond (maintenance facility) | 0.0 | 27.4 | 38.5 | 0.0 | 0.0 |
| <u>Queens</u> | | | | | |
| Flushing | 35.4 | 56.3 | 56.4 | 58.0 | 59.6 |
| TA Base Shop (no site specified) | 82.3 | 5.6 | 5.6 | 0.0 | 0.0 |
| Other | <u>0.1</u> | <u>0.3</u> | <u>0.3</u> | <u>2.1</u> | <u>6.3</u> |
| TOTAL | \$ 391.5 | \$ 400.3 | \$ 439.1 | \$ 358.3 | \$ 296.8 |

* Design funds only.

Source: 1987 Capital Plan and 1988, 1989, 1990, and 1991 Plan Amendments

The 1988 Capital Plan Amendment contained the first of many changes in the capital plan for depots. The TA base shop was deferred until the proposed third Capital Program and a Fresh Pond maintenance facility was added. The base shop was deferred as a result of a funding shortfall due to a reduction in federal grants and anticipated Coliseum revenue. Funds were also added to demolish the 54th Street Depot and prepare the site for construction of a new depot. This change resulted from the realization that the old depot was too badly deteriorated to be rehabilitated and that the construction of a new depot would have to be accelerated.

In addition, in 1988 planned commitments for the Flushing Depot increased from \$35.4 million to \$56.3 million, and planned commitments for the Manhattanville project increased from \$87.8 million to \$104.4 million. The following year, planned commitments for the Kingsbridge Depot increased by almost \$21 million. Planned commitments for the Fresh Pond maintenance facility increased as the scope of work was enlarged. However, this project was dropped from the Capital Program the following year due to the inability to coordinate it with construction activity in the adjacent train yard.

These increases were typical of the three new depot projects begun during the second Capital Program. As Table 54 shows, these increases generally represented poor initial cost estimates rather than construction cost overruns. The only new depot project experiencing significant cost overruns during construction was the Flushing Depot, which had \$2.7 million in additional work orders due primarily to design errors and omissions.

TABLE 54: Increases in the Cost of Depot Construction
(\$ in millions)

| <u>Depot</u> | <u>March 1987 Estimate</u> | <u>Estimate at Contract Award</u> | <u>4/91 Estimate of Cost at at Completion</u> | <u>4/91 Percent Increase Over 3/87 Estimate</u> |
|----------------|--------------------------------|---------------------------------------|---|---|
| Kingsbridge | \$ 65.9 | \$ 71.6 | \$ 71.8 | 9.0 |
| Manhattanville | 87.8 | 117.0 | 103.1 | 17.4 |
| Flushing | <u>35.4</u> | <u>57.7</u> | <u>64.3</u> | <u>81.6</u> |
| TOTAL | <u>\$189.1</u> | <u>\$246.3</u> | <u>\$239.1</u> | <u>26.5</u> |

Source: March 1987 Capital Plan, April 1991 TA Project Status Reports

The March 1990 plan contained the most significant changes in the 1987-91 depot program as planned commitments dropped by almost \$81 million, from \$439.1 million to \$358.3 million. Demolition and site preparation funds for the new 54th Street Depot were deleted from the 1987-91 Capital Program because of the delay in constructing the Manhattanville Depot. Hudson Pier/West Side depot funds were reduced because of the TA's inability to find a suitable site for the planned depot.

The 1991 Capital Plan Amendment continued to reduce commitments. It deferred the construction of the Gun Hill Base Shop until the third Capital Program because the TA was, according to the 1991 Plan Amendment, "reviewing its base shop strategy to determine how to best meet the needs of the Surface Department." It is disconcerting that the TA still lacks a base shop strategy ten years after it included the Gun Hill Base Shop in its Capital Program. Planned commitments for the new West Side Depot were reduced to design funds because a site still had not been selected.

From its original submission to its end, the 1987-91 Capital Plan saw the start of construction at three (Flushing, Manhattanville and Kingsbridge) of the four planned depots. West Side and the two planned base shops were not constructed.

Modernize/Rehabilitate Depots. The 1987 Capital Plan called for the modernization or rehabilitation of five depots and minor improvements to six others. The Depot Program began to change almost immediately, though. The 1988 plan cut commitments for depot rehabilitation by \$32.3 million (26 percent) from \$126.1 million to \$93.8 million. As Table 55 shows, this drop in planned

commitments was due to the decision to reconstruct rather than rehabilitate the Fresh Pond and 54th Street depots. The 54th Street Depot was too badly deteriorated to be saved and more space was needed at Fresh Pond than the existing facility provided.

The 1989 plan continued to cut funding for depot rehabilitation. While not as severe as the drop in 1988, depot rehabilitation declined by almost \$17 million, nearly 18 percent. The single largest factor in this change was the deferral of the Jamaica Depot rehabilitation project. In 1991, the TA increased its planned commitments for depot rehabilitation by adding funds for the Jamaica, 100th Street, and Walnut depots.

TABLE 55: Changes in Plans to Modernize/Rehabilitate Depots, 1987-91
(\$ in millions)

| <u>Depot</u> | <u>1987</u> <u>Plan</u> | <u>1988</u> <u>Plan</u> | <u>1989</u> <u>Plan</u> | <u>1990</u> <u>Plan</u> | <u>1991</u> <u>Plan</u> |
|---|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| Coliseum | \$ 5.4 | \$ 4.8 | \$ 4.8 | \$ 4.8 | \$ 4.6 |
| Walnut* | 1.8 | 0.0 | 0.0 | 0.0 | 10.0 |
| 146th Street | 2.0 | 5.5 | 7.3 | 7.7 | 9.4 |
| 126th Street | 1.4 | 4.0 | 6.3 | 6.7 | 7.0 |
| 100th Street (scheduled 9/91 contract award) | 0.0 | 0.0 | 0.0 | 0.0 | 3.6 |
| 54th Street | 17.0 | 0.0 | 0.0 | 4.0 | 0.0 |
| East New York | 9.9 | 12.8 | 12.3 | 12.3 | 12.5 |
| Fresh Pond | 21.5 | 0.0 | 0.0 | 0.0 | 1.2** |
| Flatbush | 16.3 | 19.6 | 24.1 | 24.0 | 26.2 |
| Jamaica | 13.7 | 15.7 | 0.0 | 0.0 | 7.5*** |
| Castleton | 5.2 | 7.0 | 7.4 | 7.7 | 7.7 |
| Yukon | 1.4 | 1.4 | 1.4 | 1.7 | 1.7 |
| Other Miscellaneous Repairs | <u>30.6</u> | <u>22.9</u> | <u>13.4</u> | <u>14.7</u> | <u>15.0</u> |
| TOTAL**** | \$ 126.1 | \$ 93.8 | \$ 77.1 | \$ 83.5 | \$106.4 |

* On hold pending New York Coliseum sale.

** Design only.

*** Emergency repairs.

**** Totals may not add due to rounding.

Source: March 1987 Capital Plan and May 1988, February 1989, March 1990 and (Proposed) December 1990 Capital Plan Amendments

Over the five-year period, planned commitments for depot rehabilitation declined almost 23 percent, from \$126.1 million in 1987 to \$106.4 million in 1991. This was largely due to the elimination of the Fresh Pond, 54th Street, and Jamaica depots from the 1987-91 Capital Program. However, the cost of those depots remaining in the program generally increased. These increases have been due to a number of factors, including low initial estimates, the need to modify designs to meet operational and regulatory requirements, additional work related to design problems, and increased construction administration costs due to construction delays.

We also found significant delays once construction began. Table 56 shows that as of December 1990 all but one of the depot rehabilitation projects had experienced at least some delay.

TABLE 56: 1987-91 Depot Rehabilitation Project Delays as of December 1990

| Depot | <u>Substantial Completion</u> | | Delay (Months) |
|---------------|-------------------------------|--------------------|-------------------|
| | <u>Original</u> | <u>As of 12/90</u> | |
| Coliseum | 1-89 | 1-89 | 0 |
| 126th Street | 3-90 | 10-90 | 7 |
| 146th Street | 3-90 | 12-90 | 9 |
| Castleton | 8-90 | 8-91 | 12 |
| East New York | 3-90 | 1-91 | 10 |
| Flatbush | 8-91 | 10-91 | 2 |
| Yukon | 6-90 | 8-90 | <u>2</u> |
| Average Delay | | | 6 |

Source: TA Engineering and Construction Department

Proposed 1992-96 Capital Program

The TA plans to build four new depots under the 1992-96 Capital Program. Three will replace the 54th Street and Jamaica depots, which were originally in the 1987-91 program, and the Hudson Pier/West Side Depot. A third Staten Island depot is planned. A new Fresh Pond maintenance building, originally in the 1987-91 Capital Program, is also planned. Rehabilitation projects include the Fresh Pond, East New York, and Walnut depots. The Fresh Pond and Walnut depots were originally part of the 1987-91 program. In addition to the depots, Surface has allocated \$134 million for base shops.

Progress Toward A State of Good Repair

As a result of the two five-year Capital Programs, the TA opened, or will open, five new bus depots, including four which replaced old depots at the same location. New depots replaced the old ones at Flushing, at Fifth Avenue and a new depot was opened at Gun Hill. Under construction are the new Kingsbridge and Manhattanville depots. This is only half as many as the TA originally intended to build by 1992. Rehabilitation and modernization has taken place at 12 depots, although it is not complete at two of these.

By the end of the third Capital Program the TA anticipates having the bus depots in a state of good repair. To accomplish this it must construct new depots at 54th Street, West Side, Jamaica, Fresh Pond, and in Staten Island. The TA will also have to complete the rehabilitation of the East New York, old Fresh Pond, and Walnut depots.

While progress is being made, we doubt that the TA will reach a state of good repair by the end of the third Capital Program. Site problems involving the West Side and Jamaica depots still must be resolved. In addition, the East New York project includes both rehabilitation and expansion into the current base shop, but this will not be possible unless the base shop is relocated. However, the TA has not yet developed a base shop policy.

STATION ISLAND RAPID TRANSIT OPERATING AUTHORITY

During the two Capital Programs, the Staten Island Rapid Transit Operating Authority (SIRTOA) earmarked funds for passenger stations, track, line equipment, power, shops/cars, security systems, and miscellaneous projects/emergency repairs. Its goals included a number of important improvements. First, it sought to extend station platforms to accommodate longer trains and to reconstruct badly deteriorated wooden stations. SIRTOA also wanted to achieve rational track and contact rail replacement cycles and to rehabilitate its 28 railroad bridges, two pedestrian underpasses, and nine pedestrian overpasses, many of which had serious deficiencies.

Other goals included installing remote-controlled track switches at Tottenville to consolidate operating locations and reduce expenses, upgrading its 14-mile signal cable system, which was above ground and subject to weather and fire damage, modernizing its power substations, and reconstructing or rehabilitating its maintenance facilities. SIRTOA also wanted to overhaul its fleet of R-44 cars which were old and in poor condition.

1982-86 Capital Program

SIRTOA committed \$43.9 million during the 1982-86 Capital Program, \$18.9 million (76 percent) more than anticipated. Most of the increase over planned commitments resulted from the addition of projects to the 1982-86 Capital Program rather than construction cost escalation.

TABLE 57: SIRTOA Capital Program Cost Growth 1982-86
(\$ in millions)

| Category | Commitments | | Difference | |
|--------------------|---------------|-------------|------------|------|
| | 1981 Estimate | 1990 Actual | Amount | Pct. |
| Passenger Stations | \$ 5.8 | \$ 7.9 | \$ 2.1 | 35 |
| Track | 2.3 | 11.1 | 8.8 | 385 |
| Line Equipment | 3.0 | 3.5 | 0.5 | 17 |
| Power | 11.0 | 13.9 | 2.8 | 26 |
| Shops/Cars | 0.6 | 3.0 | 2.4 | 400 |
| Security | 0.3 | 1.4 | 1.1 | 312 |
| Miscellaneous | 1.9 | 3.1 | 1.2 | 63 |
| Total | \$ 25.0 | \$ 43.9 | \$ 18.9 | 76 |

Source: September 1981 Capital Plan, December 1990 Proposed Capital Plan Amendment

During the 1982-86 Capital Program, SIRTOA provided funds for a number of projects:

- **Passenger Stations.** During the 1982-86 Capital Program, SIRTOA committed \$6.5 million to rehabilitate nine stations. These stations were originally expected to cost \$5.8 million. In addition, SIRTOA added \$1.4 million to prepare designs for its platform extension project scheduled for the 1987-91 program.
- **Track.** The 1982-86 program included \$4.4 million for track and contact rail replacement, \$2.1 million more than anticipated. SIRTOA added \$6.6 million to the track category to rehabilitate seven railroad bridges and one underpass with serious structural deficiencies.
- **Line Equipment.** Commitments for the Tottenville interlocking project totalled \$3.1 million, just \$100,000 more than expected. SIRTOA added \$400,000 to the 1982-86 line equipment budget to purchase new signal cable and related materials which were used during the 1987-91 signal system replacement project.
- **Power.** SIRTOA committed \$700,000 for new supervisory power control equipment at the St. George Terminal to centralize control of five equalizer breaker houses and five substations located along the right-of-way. It also replaced outdated rotary converters with modern silicon rectifier equipment at the St. George, Eltingville, Atlantic, and Old Town power substations. The cost of the new equipment was \$13.9 million, \$2.8 million more than anticipated.
- **Shops/Cars.** The 1982-86 Capital Program contained \$1.3 million to design new headquarters for SIRTOA's Maintenance-of-Way staff and police force and to design a new Clifton Diesel Shop. Actual construction was scheduled for the 1987-91 program. An additional \$1.7 million was added to cover the costs of settling SIRTOA's contractual dispute with a private contractor who defaulted on the R44 car overhaul contract.
- **Other Projects.** SIRTOA committed \$1.4 million to replace cyclone fencing along its right-of-way and \$3.1 million for miscellaneous equipment purchases and emergency repair needs.

1987-91 Capital Program

The December 1990 proposed Capital Program Amendment called for \$111 million to be committed during the 1987-91 Program, \$42.2 million (61 percent) more than the \$68.8 million estimate of March 1987 (see Table 58). The increase over the March 1987 estimate was caused primarily by increases in the cost of station platform extensions and the inclusion of the R-44 car overhaul project in the second Capital Program (the overhaul project was originally part of the 1982-86 program).

TABLE 58: Comparison of SIRTOA Cost Estimates, 1987-91
(\$ in millions)

| Category | Commitments | | Difference | |
|--------------------|----------------|-----------------|----------------|-----------|
| | 1981 Estimate | 1990 Actual | Amount | Pct. |
| Passenger Stations | \$ 14.2 | \$ 29.8 | \$ 15.6 | 110 |
| Track | 26.7 | 22.0 | -4.7 | -17 |
| Line Equipment | 2.5 | .9 | -1.6 | -64 |
| Shops/Cars | 14.6 | 51.8 | 37.2 | 254 |
| Security | 4.3 | 5.3 | 1.0 | 22 |
| Miscellaneous | 6.5 | 1.2 | -5.3 | -81 |
| Total* | \$ 68.8 | \$ 111.0 | \$ 42.2 | 61 |

* No funds were committed for power projects during the 1987-91 Capital Program.

Source: March 1987 Capital Plan, December 1990 Proposed Capital Plan Amendment

In March 1987, SIRTOA estimated that it would cost \$14.7 million to extend platforms at 16 of its 22 stations and to rehabilitate pedestrian overpasses at five stations. However, the winning bids for the station contracts were much larger than SIRTOA expected. According to the December 1990 proposed Capital Program Amendment, the project will cost \$27 million, \$12.3 million (84 percent) more than SIRTOA's initial estimate.

The \$37.2 million increase in the budget for shops and cars resulted when the major overhaul of SIRTOA's R-44 railroad cars was added to the 1987-91 Capital Program. Originally, SIRTOA had included \$18.3 million in the 1982-86 program to overhaul its fleet of 52 R-44 cars. In January 1987, SIRTOA awarded a contract to a vendor which covered the overhaul of the 52 cars plus an option to overhaul 12 additional R-44 cars that had been transferred from the TA to meet SIRTOA's ridership needs.

After ten cars were partially overhauled, the TA determined that the vehicles could not pass tests measuring stress on the car body. The TA directed the vendor to stop working on the cars and submit a change order to correct the structural problems. The vendor refused and was held in default.

The TA agreed to pay the vendor for its partial overhaul of the ten cars and for parts already purchased for the remaining overhaul work. All 64 cars were then scheduled for in-house overhaul at TA shops during the 1987-91 period. According to the December 1990 proposed Capital Plan Amendment, SIRTOA added \$36 million to the 1987-91 Shops/Cars budget to cover the cost of the in-house overhaul.

By December 1990, the total cost of overhauling the cars had risen to \$39.7 million, due to increased TA labor and in-house inspection costs. These increases were caused by the substantial rework required on the ten partially overhauled cars and by the addition of five supervisors to the project to improve the quality of work being performed.

Proposed 1992-96 Capital Program

During the 1992-96 Capital Program, SIRTOA plans to invest \$155 million in the following capital projects:

- \$26 million for rehabilitating the six remaining stations and lengthening them to accommodate five-car trains. An additional \$2.2 million is earmarked for installing public address systems in all stations;
- \$25 million is allocated for track, contact rail, and switch replacement along the right-of-way. An additional \$19 million in proposed commitments is for the renovation of line structures, including the St. George Terminal and the Tidewater Mill Creek Bridge;
- Line equipment proposals include \$68 million to install state of the art moving block signals to improve operational flexibility during peak hours, equipment breakdowns, and track repairs; and
- \$9 million is earmarked for the rehabilitation of the Tompkinsville Shop and \$6 million for other miscellaneous projects.

Progress Toward a State of Good Repair

According to SIRTOA's Acting Director of Capital and Special Projects, 16 of 22 passenger stations will be in good repair by the end of 1991. The remaining six stations are scheduled to be rehabilitated by 1994.

The Acting Director also stated that by the end of 1991, ten of SIRTOA's 28 miles of track and contact rail will have been replaced and be in good repair; 15 additional track miles are planned for replacement by 1996, with the remaining track work scheduled for later Capital Programs.

By the end of 1991, SIRTOA will have completed the first phase of its 14-mile signal replacement project. The installation of moving block signals is planned to be completed in 1996. This will bring the entire system to a state of good repair.

In addition, all SIRTOA shops and maintenance facilities, except for the Tompkinsville non-revenue Shop, reached a state of good repair during 1991. Tompkinsville is scheduled for renovation during the 1992-96 Capital Program. The R-44 car overhauls were substantially completed during 1991, bringing SIRTOA's fleet to a state of good repair.

LONG ISLAND RAIL ROAD

OVERVIEW

Prior to 1981, the Long Island Rail Road (LIRR) faced serious problems due to an insufficient car fleet, antiquated shop facilities, inadequate lay-up yards, and out-moded or overaged track equipment including interlockings, signals, and switches. In addition, many of its passenger stations needed upgrading, and platforms needed to be either extended or totally replaced.

These inadequacies in its physical plant led to significant operational deficiencies. For example, the insufficient car fleet resulted in thousands of commuters standing during rush hours. Maintenance facilities, some constructed prior to 1900, were inadequate to handle even the existing fleet. Diesel hauled coaches were serviced outdoors for lack of an enclosed facility. Overaged track equipment such as interlockings and signals also caused congestion and delays.

The LIRR planned to spend approximately \$2.1 billion from 1982 to 1991 for its capital needs. Capital Program priorities have shifted significantly between the two five-year plans as can be seen in the allocations for most categories, but especially for shops and yards, line structures, and passenger stations (see Table 59).

TABLE 59: 1982-91 LIRR Capital Program
(\$ in millions)

| Category | Planned Commitments | | | | | |
|-----------------------------|---------------------|-------|------------|-------|-----------------|-------|
| | 1982-1986 | | 1987-1991 | | Total 1982-1991 | |
| | Amount | Pct. | Amount | Pct. | Amount | Pct. |
| Cars | \$ 190.5 | 17.3 | \$ 71.4 | 6.8 | \$ 261.9 | 12.2 |
| Passenger Stations | 79.7 | 7.2 | 254.8 | 24.4 | 334.4 | 15.6 |
| Track | 41.6 | 3.8 | 173.0 | 16.6 | 214.6 | 10.0 |
| Line Structures | 13.5 | 1.2 | 144.6 | 13.9 | 158.2 | 7.4 |
| Signals & Communications | 51.4 | 4.7 | 199.1 | 19.1 | 250.5 | 11.7 |
| Shops & Yards | 536.4 | 48.8 | 87.8 | 8.4 | 624.2 | 29.1 |
| Security | 1.3 | 0.1 | 0.0 | 0.0 | 1.3 | 0.0 |
| Electrifications/Extensions | 176.6 | 16.1 | 62.5 | 6.0 | 239.1 | 11.2 |
| Miscellaneous | 7.3 | 0.7 | 50.5 | 4.8 | 57.9 | 2.7 |
| Total | \$ 1,098.5 | 100.0 | \$ 1,043.7 | 100.0 | \$ 2,142.2 | 100.0 |


Source: December 1990 Proposed Capital Plan Amendment

As part of its 1982-86 Capital Program, the LIRR bought more than 170 new electric cars and in 1987 it opened a new train storage yard near Penn Station. Work on the Hillside Maintenance Complex was begun to provide a comprehensive facility for car maintenance and overhauls and in 1983 a new shop was built at Richmond Hill for diesel-hauled cars. In addition, the LIRR spent \$42 million to bring track and third rail to a state of good repair.

Electrification of the Main Line from Hicksville to Ronkonkoma, completed in 1987, allowed more and longer trains to run during peak service and reduced travel time. A second electrified track from Syosett to Huntington on the Port Jefferson Branch was put in operation in mid-1987. Improvements to Penn Station were also undertaken during the first Capital Program.

The second Capital Program focused on stations, with outlying stations, Jamaica, and Penn Station all receiving attention. Almost \$200 million was targeted for improving passenger access and climate control at Penn Station from 1982 to 1991. Another major focus was line structures, which included projects to replace a railroad bridge in Reynolds Channel in Island Park, Town of Hempstead, repair several viaducts and modernize Jamaica interlockings.

The 1987-91 program allocated almost \$200 million for signals and communications projects, a major emphasis compared to the first Capital Program. Signal improvements on the Port Jefferson Branch were addressed and the major thrust was the completion of reverse signaling from Jamaica to Penn Station, including rebuilding the Harold Interlocking.



The LIRR's 1987-91 Capital Program is marked by a number of funding shifts, deferred projects and delays. These changes most often resulted from management decisions to fund large budget overruns and to cancel projects deemed of lower priority. Below are the major problems found in each of the LIRR Capital Program categories.

- Testing the LIRR's new technology cars and locomotives has been delayed and these prototypes will cost much more than expected.
 - o Three prototype dual-mode locomotives are 16 months late and will cost more than double the original estimate.
 - o Testing the LIRR's ten new bi-level cars was delayed six months because of the dual-mode locomotive delay. This project's budget has also almost doubled from its original estimate.
- Most goals for LIRR stations were met, but one project was substantially increased and several others were scaled back or dropped.
 - o From 1986 to 1990, the LIRR continually revised the scope of Penn Station improvements, increasing the project budget from \$90 million to \$198 million (120 percent).

Station improvements

- o The LIRR deferred a \$9.3 million refurbishment of the aging Flatbush Avenue Terminal and \$7.5 million in repairs to the Hunterspoint Avenue Station in response to uncertainty about development activities by the City and MTA and the need for additional funding for Hillside.
- The LIRR met or exceeded most of its goals for its annual track rehabilitation programs from 1987 through 1990.
- The LIRR deferred or substantially reduced the scope of several line structures projects. Of the \$312 million originally budgeted, only \$145 million was expected to be committed by the end of 1991 (54 percent).
 - o Modernizing the Jamaica Complex, including its track, signal system and interlockings, was substantially scaled back. More than \$200 million budgeted for this project was transferred to other needs.
 - o Replacing a railroad bridge in Reynolds Channel cost twice what the LIRR first estimated because it could not be built at the planned location.
 - o From 1987 to 1990, estimates for repairing the Atlantic Avenue Viaduct have risen tenfold from \$14 million to \$140 million. The project has been delayed several years as the LIRR sought three consultants' opinions on the viaduct's condition.
- Most of the increase in the signals and communications budget stems from an increase in one major project which was partially offset by a canceled project.
 - o The reverse signaling project from Jamaica to Penn Station included work on the Harold Interlocking which rose by over \$23 million to complete the work faster than originally planned.
 - o The LIRR canceled the \$20 million Jamaica to Valley Stream reverse signaling project when it reduced the scope of the Jamaica Complex project and decided the signal project had little benefit.
- Most of the 1987-91 shops and yards budget was spent on finishing work at Hillside. The LIRR also dropped two projects totalling \$29 million to offset overruns in other projects.
- The LIRR changed its strategy on extending electrified track and cut its \$130 million electrification budget in half. Most of the cut came from scaling back the Main Line Third Track project.

CARS

In 1980 the LIRR operated 764 electric cars and 250 locomotive-hauled coaches. Over 12,000 commuters were forced to stand during their peak hour commutes and crowded trains led to long station dwell times. At that time, the railroad projected that morning peak service would increase by 9,000 passengers from 1981 to 1986, thus causing additional strain on its car fleet and maintenance facilities.

1982-86 Capital Program

The LIRR's first Capital Program originally budgeted \$252.5 million for car purchases, but the railroad actually committed \$190.5 million for this category, a reduction of \$62.0 million (25 percent). The main reason for the decrease was that LIRR purchased fewer new electric cars than originally planned.

TABLE 60: 1982-1991 LIRR Cars Program
(\$ in millions)

| Period | Commitments | | Change | |
|---------|---------------|--------------------|----------|---------|
| | Original Plan | Current Projection | Amount | Percent |
| 1982-86 | \$ 252.5 | \$ 190.5 | -\$ 62.0 | -25 |
| 1987-91 | 30.7 | 71.4 | 40.7 | 132 |

Source: September 1981 and March 1987 Capital Plans; December 1990 Proposed Capital Plan Amendment

In 1981, the LIRR estimated that it needed to purchase "up to 216" new M-3 cars to significantly reduce its standee problem. The LIRR eventually purchased 174 new M-3 cars which were added to the fleet in 1986. According to the 1990 Capital Plan Amendment, the LIRR actually spent \$185.5 million for these cars. Approximately \$5 million was added to the program to overhaul the interiors of 170 existing diesel-hauled cars.

1987-91 Capital Program

While the first Capital Program emphasized expanding the car fleet to handle increased ridership, the second Capital Program stressed new technology in locomotive and car design as a means to deal with service to outlying areas. As shown in Table 60, the 1987-91 Capital Program budgeted \$30.7 million for rolling stock. However, by December 1990 the LIRR estimated that it would commit \$71.4 million, an increase of \$40.7 million (132 percent). Budget increases for dual-mode locomotives and bi-level cars largely caused this increase.

The 1987 plan called for a joint project with Metro-North to purchase three new dual-mode locomotives for testing and evaluation. The LIRR expected that if the tests were successful, these locomotives would be used for service on non-electrified branches.

In 1987 the LIRR estimated that its share of the dual-mode project would cost \$10.7 million. By December 1990, this amount had reached \$23.9 million for the 1987-91 period. This large increase resulted from changes in the locomotives' design and substantial delays in completing their assembly. O'Brien-Kreitzberg attributed the problems to poor management and design, inadequate quality control and insufficient supervision. (See the discussion of the causes of delays in the Metro-North section on page 111.)

Ten bi-level cars were to be used with the dual-mode locomotives in a prototype train to assess the possible replacement of diesel hauled coaches and the potential development of bi-level electric cars.

The bi-level car project also had a substantial budget increase and significant delays. In 1987, the LIRR estimated that 12 new bi-level cars would be purchased for approximately \$18.7 million. By December 1990, that estimate had increased to \$40.6 million for ten cars.

The LIRR's original plan was to award a design/build contract by December 1987 for completion in 1990. According to the LIRR project manager, additional design changes, new engineering estimates and a change in LIRR top management all contributed to a budget increase in May 1988 bringing it to \$24.3 million. In October 1988 the LIRR awarded a contract to Mitsui & Co. USA for \$21.95 million for ten bi-level cars to be delivered by late 1990.

Almost \$5 million was added to the project in 1990. Part of this increase was attributed to a six-month manufacturing delay of the dual-mode locomotives. The increase was also needed for clearing obstructions in the East River tunnels and Penn Station, and for providing additional electrical power at Richmond Hill Yard to test the new coaches.

The 1991 Capital Plan Amendment added an additional \$9 million, bringing the budget to \$40.6 million. This increase was partially due to added work and "possible damages" to Mitsui as a result of the failure to provide dual-mode locomotives for scheduled testing according to the contract terms. Costs also increased for consultant services, to store and maintain ten bi-level coaches during the six-month testing delay, and to clear tunnel obstructions.

The LIRR has begun testing the bi-level cars using modified locomotives from Metro-North and Chicago's commuter railroad. The LIRR put these cars into revenue service on the Port Jefferson Branch in August 1991 using the borrowed locomotives until two existing LIRR locomotives can be modified to run the new coaches' operating systems. This equipment will be used until the dual-mode locomotives are delivered. According to the LIRR project manager, approximately \$1.5 million in increased bi-level coach costs will eventually result from the delays in the manufacture of the dual-mode locomotives.

In September 1991, the LIRR reduced the project's budget, to release contingency funds and reflect lower than expected program management costs and a transfer of funds needed for tunnel clearance to another joint project with Amtrak. As a result of these changes, as of September 1991 the project budget stood at \$35 million.

Proposed 1992-96 Capital Program

Since LIRR electric cars are still within their 30-year useful life, they are not due for replacement until after the proposed 1992-96 Capital Program. However, the diesel fleet will reach the end of its useful life during the 1992-1996 period.

The current \$319 million replacement plan calls for purchasing 40 diesel locomotives, 16 cab cars, and 128 single-level diesel hauled coaches. The LIRR also plans to keep its three dual-mode locomotives and 10 bi-level coaches in operation.

The LIRR believes this in-kind replacement strategy is the most flexible and least costly alternative, given the still-uncertain performance of the newer equipment being tested. Depending upon their performance, some number of bi-level coaches and/or dual-mode locomotives may be substituted for the equipment mentioned above.

Progress Toward a State of Good Repair

The LIRR's rolling stock attained a state of good repair in 1986. Replacing coaches and locomotives in the diesel fleet is part of a normal replacement cycle for car equipment that reaches the end of its useful life.

PASSENGER STATIONS

In 1981, many of the LIRR's 140 stations, including Penn and Jamaica stations, required upgrading. The railroad needed to replace 62 low-level platforms with concrete high-level platforms to reduce passenger loading and unloading times and to permit the centralized control of train doors. In addition to replacing the asphalt-covered strips serving as low-level platforms, the LIRR also needed to extend or replace a large portion of its 147 high-level platforms.

1982-86 Capital Program

In 1981, the LIRR budgeted \$31.2 million for its passenger stations. By the end of the 1982-86 Capital Program, \$79.7 million had been committed, an increase of \$48.5 million (155 percent). The increase was largely due to a \$26.4 million increase in Penn Station projects and the addition of projects to rehabilitate outlying stations.

TABLE 61: 1982-91 LIRR Stations Program
(\$ in millions)

| Period | Commitments | | Change | |
|---------|---------------|--------------------|---------|---------|
| | Original Plan | Current Projection | Amount | Percent |
| 1982-86 | \$ 31.2 | \$ 79.7 | \$ 48.5 | 155 |
| 1987-91 | 163.9 | 254.8 | 90.9 | 55 |

Source: September 1981 and March 1987 Capital Plans; December 1990 Proposed Capital Plan Amendment

The 1981 plan for Penn Station included installing high-speed escalators, improving air-conditioning and ventilation systems and constructing a new West End Concourse. The LIRR also proposed constructing a new Landia Station on the Port Jefferson Branch between Hicksville and Syossett. Construction of the new Landia Station depends on other jurisdictions providing funds for the non-railroad parts of the project. The LIRR expanded its stations program in mid-1983 when the MTA added funds to improve platforms and stations on the Port Jefferson, Montauk and Main Line branches.

During the 1982-86 Capital Program, the LIRR completed several station projects. A new West End concourse and a crew ticket office were constructed at Penn Station. Ramps, elevators, and pedestrian overpasses were installed at a number of stations. High-level platforms were built at several stations and a conceptual design for the proposed Landia Station was completed.

1987-91 Capital Program

In 1987, the LIRR budgeted \$163.9 million for passenger stations. In December 1990, the LIRR expected to commit \$254.8 million for this category, a \$90.9 million increase (55 percent). This increase was primarily due to a \$97 million increase for Penn Station improvements and a new \$20 million parking program. These increases were offset by reductions in several other projects and the deferral of \$17 million of improvements to Hunterspoint and Flatbush Avenue Stations. Table 62 shows the elements comprising the stations category and the budget changes from 1987 to late 1990.

TABLE 62: 1982-91 LIRR Passenger Stations Program Elements
(\$ in millions)

| Project | Commitments | | Change | |
|------------------------------------|---------------|--------------------|---------|---------|
| | Original Plan | Current Projection | Amount | Percent |
| Penn Station Passenger Access | \$ 59.7 | \$ 156.8 | \$ 97.1 | 163 |
| Various Station Improvements | 5.1 | 1.7 | -3.4 | -67 |
| Port Jefferson Branch Improvements | 12.6 | 8.3 | -4.3 | -34 |
| Main Line Improvements | 5.6 | 8.7 | 3.1 | 55 |
| West End Terminal Improvements | 17.6 | .5 | -17.1 | -97 |
| High-Level Platform Improvements | 40.9 | 41.2 | .3 | 1 |
| Passenger Information Improvements | 0.0 | 3.3 | 3.3 | -- |
| Ticket Sales & Fare Collection | 22.4 | 14.3 | -8.1 | -36 |
| Parking Improvements | 0.0 | 20.0 | 20.0 | -- |
| Total | \$ 163.9 | \$ 254.8 | \$ 90.9 | 55 |

Source: March 1987 Capital Plan and December 1990 Proposed Capital Plan Amendment

Plans for improving Penn Station began in 1981 and evolved over the past decade as projects and funds have been added, revised and deferred. Originally, the LIRR planned to improve passenger circulation, increase access for the elderly and handicapped, and build a new West End Concourse. In 1983, the LIRR decided to modernize two subway mezzanines, upgrade electrical systems, install platform ventilation and create an East End waiting area. By 1985 the platform ventilation project had been deferred and elderly and handicapped elevators had been added to its scope.

Though the LIRR completed several major improvements, including the West End Concourse, two subway mezzanines, and improved ticket offices, the LIRR continued to revise the project from 1986 to 1990. Having deferred work on the electrical distribution system and the East End Waiting Area in 1986, the railroad increased the project budget in 1987 and added them back. Also added at that time were an Exit Concourse, a Connecting Concourse, and a rehabilitated Main Gate Waiting Area. Higher cost estimates and reconfigured control areas to accommodate Automated Fare Collection led to further changes in 1988.

In 1990, the LIRR transferred \$59 million from the Penn Station construction project to the reserve category to re-evaluate the work scope and delay the project until new LIRR management was in place. In 1990, \$59 million was transferred back to the project and \$69.4 million was added for Penn Station construction. During 1990 the project was revised by adding a 34th Street passageway. This brings the project's total budget since 1981 to \$198 million.

The Port Jefferson Branch's new Landia Station was planned to help alleviate overcrowding in the area between Hicksville and Syosset. At the request of local legislators, the railroad budgeted \$5 million, but then postponed this project because the railroad wanted the town to construct access roads. Additionally, the surrounding property is owned by the Town of Oyster Bay and is a closed public landfill. The town is negotiating with the U.S. Environmental Protection Agency (EPA) on how to cap the landfill.

The railroad will not start constructing the new station until all environmental issues are resolved and new roads are constructed. In 1991, the LIRR transferred \$5 million from the project to cover increases in other capital projects and deferred the Landia Station project to the proposed 1992-96 Capital Program.

The improvements to the Main Line are due to two additions to the work scope for Ronkonkoma Station. First, the railroad included two elevators to serve the handicapped. In early 1990, the Urban Mass Transportation Administration (UMTA) suggested that the LIRR add canopies to the proposed platforms to cover passengers in inclement weather.

The LIRR canceled improvements to two West End Terminals and transferred almost \$16 million to other projects. The original plans for the Flatbush Avenue Terminal Improvements called for structural repairs, refurbished employee welfare facilities, and improved lighting, heating and ventilation systems. However, due to uncertainties about a concurrent overbuild project to be undertaken by a developer, the project was deferred to provide funds for Hillside.

The Hunterspoint Station Improvement project originally called for upgrading the existing station. However, the LIRR placed the project on hold until the MTA decided on its plans to renovate the entire area. Approximately \$7.5 million in funds for this project were transferred to cover increases in other projects.

The railroad had budgeted \$5 million to upgrade and extend platforms at Amityville, Copiague, Lindenhurst, and Babylon. However, needing money for other projects, this project was downscoped to extending platforms only at the Babylon Station. The platform extensions at the remaining stations were deferred to a future Capital Program.

The LIRR planned to replace 17 old and out-moded platforms. As a result of rising costs and the need to install elevators for the handicapped at two stations, the Douglaston, Huntington, and Woodside stations were deferred. Of the 14 remaining platforms, ten were completed and four are scheduled to be done by the end of 1991. In June 1991, the MTA Board approved restoration of the Douglaston project with a budget of \$2.6 million.

The Station Signage project originally called for new signs at 72 of the 109 LIRR stations; the remaining 37 were to be done under a future Capital Program. However, in June 1989, the LIRR reduced the project scope from 53 to 25 stations to fund higher priority projects. The LIRR also cut back its Ticket Sales and Revenue Collecting project; it halved the number of ticket vending machines it planned to install and also scaled back other fare equipment.

Proposed 1992-96 Capital Program

The LIRR has proposed spending \$143.7 million for further improvements to its passenger stations during the proposed third Capital Program. Penn Station's Platform 11 will be extended from eight to 12 car lengths and a new track will be built to the West Side Storage Yard. Existing high-level platforms at Huntington, Far Rockaway, and Long Beach will be replaced, and shelters, ramps, new lighting and public address systems will be installed.

The LIRR also proposes rehabilitating Jamaica Station, Flatbush Avenue Terminal and 16 other heavily used stations. The railroad's proposed plan notes that the improvements at Flatbush Avenue Terminal are linked to a Master Plan for that facility being prepared jointly by the MTA, TA, and LIRR.

The LIRR also wants to replace or rehabilitate existing exterior escalators at seven stations and make seven station buildings and platforms more accessible to the disabled. Signs will be installed at 23 stations, continuing an effort begun under earlier programs.

Finally, the LIRR, in conjunction with Nassau and Suffolk counties and other MTA agencies, plans to study regional transportation hubs and potential commuter parking facilities.

Progress Toward a State of Good Repair

The LIRR expects that work at Penn Station will be completed by 1995 and that all passenger stations will have achieved a state of good repair at that time. By deferring several station projects from its 1987-91 Capital Program, the railroad will take longer to reach this goal than it had originally planned.

TRACK

Between 1970 and 1980, the LIRR replaced a major portion of its 530 miles of track in the electrified and diesel zones with new continuous welded rail. New ties, switches and subbase were also installed. Replacing bolted rail with continuously welded rail reduces noise and vibration, provides a smoother ride, and requires less track and car maintenance. In the electrified territory, track rehabilitation includes replacing broken or deteriorated third rail components.

1982-86 Capital Program

In 1982, the LIRR budgeted \$75.9 million for track work (see Table 63). At the conclusion of the 1982-86 Capital Program, it had committed \$41.6 million, a reduction of \$34.3 million (45 percent). This decrease resulted from transferring two major electrification projects to another Capital Program category, and adding several new track projects.

TABLE 63: 1982-91 LIRR Track Program
(\$ in millions)

| Period | Commitments | | Change | |
|---------|---------------|--------------------|----------|---------|
| | Original Plan | Current Projection | Amount | Percent |
| 1982-86 | \$ 75.9 | \$ 41.6 | -\$ 34.3 | -45 |
| 1987-91 | 150.4 | 173.0 | 22.6 | 15 |

Source: September 1981 and March 1987 Capital Plans; December 1990 Proposed Capital Plan Amendment

The 1981 Capital Plan called for additional mainline track in two single-track areas: the Port Jefferson Branch between Syosett and Northport and the Main Line between Republic and Ronkonkoma. In 1982, to coordinate the awarding of electrification contracts, the LIRR transferred the double tracking from Syosett to Northport project to the electrification program. In 1983, the railroad transferred the Main Line project to the electrification category budget.

In 1983, the LIRR added a \$13 million project to rehabilitate East River tunnel tracks and in 1985, the railroad added \$34.7 million for ongoing third rail and track rehabilitation programs. Before this, the LIRR's annual track replacement program was funded from its operating budget. In 1984, the MTA issued uniform guidelines to be used at all MTA operating agencies for determining capital funding eligibility for projects. These included a seven-year-life criterion, which applied to all agencies' track programs.

1987-91 Capital Program

In 1987, the LIRR budgeted \$150.4 million for track improvements. In December 1990, the railroad expected to commit \$173 million for track-related work from 1987 to 1991, an increase of \$22.6 million (15 percent). A new \$10.4 million project, installing 129 inductive reactors at 38 substation locations to enhance detection of broken rails and correct a potential safety problem, made up almost half of the increase, and increases in annual track and third rail rehabilitation programs accounted for the balance.

The LIRR's track rehabilitation included upgrading Jamaica Complex track to a state of good repair. In 1990, the railroad allocated \$19.3 million to rehabilitate switches, running rail, ties, timbers, third rail, ducts, air lines, signal cables, track and heater wires, and to install new drainage materials. This track rehabilitation project was created when the LIRR deferred the more ambitious Jamaica Complex Improvements project which had originally included extensive track, switch and signal work in the Jamaica area (discussed in more detail on page 94).

Most of the track budget was devoted to upgrading third rail and track. Third rail replacement consists of installing 40,000 feet of new composite third rail and 80,000 feet of protection board annually. The track program calls for replacing about 17 miles of running rail per year, ties, ballast and switches, and includes surfacing work. The LIRR has met or exceeded most of its goals for the track rehabilitation program during each of the past four years (see Table 64).

TABLE 64: 1987-90 LIRR Annual Track Rehabilitation

| Track Work | Percent Of Work Completed | | | |
|------------------|---------------------------|------|------|------|
| | 1987 | 1988 | 1989 | 1990 |
| Welded Rail | 100 | 103 | 110 | 101 |
| Ties | 100 | 100 | 110 | 111 |
| Switches | 100 | 87 | 103 | 67 |
| Crossings | 100 | 116 | 100 | 113 |
| Ballast | 100 | 114 | 149 | 63 |
| Third Rail | 100 | 103 | 102 | 109 |
| Protection Board | N/A | 104 | 100 | 100 |

Source: LIRR Capital Program Summary Progress Reports; LIRR Engineering Department Goals and Accomplishments Report

In 1989, the railroad also purchased a new \$1.7 million track geometry car to monitor track conditions and identify exceptions to LIRR track standards.

Proposed 1992-96 Capital Program

The LIRR's proposed third Capital Program includes \$234.7 million for its annual track and third rail rehabilitation programs and for several other track

projects. Track rehabilitation accounts for \$209.6 million (89 percent) of the total. Besides replacing worn track components, obsolete or deteriorated structures along the right-of-way will be demolished or rehabilitated. The Atlantic Branch Interlocking project will convert obsolete equipment to state-of-the-art technology, upgrade power lines and switches, and remove asbestos contained in cable manholes. Almost \$11 million is proposed for track rehabilitation in Penn Station.

Progress Toward a State of Good Repair

The LIRR achieved a state of good repair for its track in 1985. Since then it has programmed capital funds into annual rehabilitation efforts to replace track, third rail and other track system components on a cyclical basis before they deteriorate and become possible safety hazards.

LINE STRUCTURES

The Long Island Rail Road system includes 18.5 miles of tunnels and 18.8 miles of elevated structures. Because of inadequate preventive maintenance, many of these structures needed extensive repair work. Problems developed in the tunnels under the East River and Atlantic Avenue where water infiltrating the tunnel can damage signal components. Steel bridges and viaducts suffered from corrosion caused by inadequate painting in prior years.

In late 1980, the LIRR reported that over the next decade capital work would be required to repair tunnel lighting, fix leaking expansion joints and replace tunnel trackage. Major repairs on elevated structures included replacing unsafe structural components and repairing concrete supports.

1982-86 Capital Program

In 1981, the LIRR budgeted \$67.2 million for its line structures (see Table 65). At the conclusion of the 1982-86 Capital Program, \$13.5 million had been committed, a reduction of \$53.7 million (80 percent). This large decrease occurred because the LIRR did no significant capital work on its elevated structures and tunnels, and undertook projects not included in the original 1982-86 Capital Program.

TABLE 65: 1982-91 LIRR Line Structures Program
(\$ in millions)

| <u>Period</u> | <u>Commitments</u> | | <u>Change</u> | |
|---------------|--------------------------|-------------------------------|---------------|----------------|
| | <u>Original Plan</u> | <u>Current Projection</u> | <u>Amount</u> | <u>Percent</u> |
| 1982-86 | \$ 67.2 | \$ 13.5 | -\$ 53.7 | -80 |
| 1987-91 | 312.4 | 144.6 | -167.8 | -54 |

Source: September 1981 and March 1987 Capital Plans; December 1990 Proposed Capital Plan Amendment

The 1981 Capital Plan did not focus on tunnels and bridges but on upgrading interlockings. The LIRR system includes 39 interlocking locations of various sizes and complexity. Jamaica has three interlockings constructed in 1913 which could barely handle 1981 train operations. Penn Station's towers, track and switching configuration date back to 1910, and a new control center was needed.

In 1983, another line structure project was added to the Capital Program. The bridge and wooden trestle over Reynolds Channel in Island Park, Town of Hempstead, was antiquated and unreliable. This caused frequent delays because train speed was limited to five miles an hour. The 1982-86 Capital Program funded the original design work for the new bridge and trestle replacement project. Construction carried over into the 1987-91 program where serious problems arose when the LIRR's choice of keeping the bridge in the same location over an existing natural channel conflicted with the requirements of the Town and Coast Guard. (This project is discussed in more detail on page 149.)

The December 1990 Capital Plan Amendment summarized the accomplishments of the 1982-86 lines structure program as installing fire extinguishers and smoke doors along the walls of the East River tunnels. Regarding the Jamaica Interlocking modernization project, the plan amendment notes that "an access route to the Hillside Maintenance Complex was completed in February 1989."

1987-91 Capital Program

In 1987, the LIRR budgeted \$312.4 million and expanded the goals of the line structures category from upgrading interlockings to ensuring the integrity of bridges, viaducts and tunnels. However, because several projects were either deferred or substantially reduced in scope, the 1987-91 Capital Program committed only \$144.6 million, a reduction of \$167.8 million (54 percent) from the original 1987 budget level.

The 1987-91 line structures program includes eight elements, most consisting of just one project. As can be seen in Table 66, several elements' budgets varied substantially from 1987 to 1990. Additionally, some projects were seriously delayed.

TABLE 66: 1987-91 LIRR Line Structures Elements
(\$ in millions)

| Element | Commitments | | Change | |
|--|-----------------|--------------------|------------------|------------|
| | Original Plan | Current Projection | Amount | Percent |
| Modernize Jamaica Interlocking | \$ 243.4 | \$ 41.9 | -\$ 201.5 | -83 |
| Wreck Lead Swingbridge Replacement | 12.3 | 26.1 | 13.8 | 112 |
| Manhasset Viaduct Repair | 7.4 | 10.4 | 3.0 | 41 |
| Other Viaduct Repair | 17.7 | 34.8 | 17.1 | 97 |
| Atlantic Branch Interlocking | 6.3 | 4.7 | -1.6 | -25 |
| Replace 25 Hz Power with 60 Hz | 7.4 | 4.5 | -2.9 | -39 |
| Penn Station Infrastructure Improvements | 17.9 | 19.6 | 1.7 | 9 |
| Garden Interlocking | <u>0.0</u> | <u>2.7</u> | <u>2.7</u> | <u>--</u> |
| Total | <u>\$ 312.4</u> | <u>\$ 144.6</u> | <u>-\$ 167.8</u> | <u>-54</u> |

Source: March 1987 Capital Plan and December 1990 Proposed Capital Plan Amendment

Jamaica Station Complex. Modernization of the Jamaica Interlocking began during the 1982-86 Capital Program. Its scope was greatly expanded for the 1987-91 Capital Program to include several other projects involving the Jamaica Station Complex. Just a small portion of what was planned was actually completed.

The original plan for Jamaica Station included upgrading switches and signals, improving track configurations, consolidating three control towers into one master tower, and reconfiguring express tracks, bypasses and platforms. In 1988 the project scope was reduced, deleting the construction of express tracks, bypasses, and platform changes. A pedestrian bridge with six elevators accessible to the elderly and disabled was completed in 1990.

In the 1991 Plan Amendment, the project scope was further reduced to rehabilitating the track at Jamaica to a state of good repair. This rehabilitation project will be done as part of the LIRR's 1991 track program.

The railroad reduced the scope of the project because of financial, operational and rehabilitational issues. In 1988, the LIRR needed to increase the budget for the Hillside facility and it evaluated all projects to see how well budgets matched project requirements. Hillside, the Penn Station projects, and the Atlantic Avenue Viaduct repair project were allocated some of the money from the Jamaica Station Complex.

Operational and demand-related issues also convinced the LIRR that the Jamaica Station Complex was a good candidate for deferral. When the LIRR established the original scope for Jamaica, it believed that commuter demand would increase. But commuter demand has plateaued and the railroad no longer believes that ridership will grow as much as originally estimated.

Finally, computer simulations of operations through Jamaica performed during the design phase showed that travel times could be reduced by only two to four minutes. These reductions were not as great as was originally hoped. In addition, any improvements in Jamaica will be limited by constraints in Penn Station and the East River tunnels.

Wreck Lead Swing Bridge Replacement. This project, initiated in the first Capital Program and completed in May 1988, called for replacing the bridge over the Reynolds Channel with a bridge purchased from a town in Florida. The old bridge had to be replaced because it had deteriorated and was no longer reliable.

The cost of the project doubled, from \$14.9 million to \$28.5 million, because the replacement bridge was not permitted to be built where the existing bridge was located due to concerns by officials of the Town of Hempstead about pleasure craft traveling in Reynolds Channel. This change necessitated design modifications and additional construction work. A deadline imposed by the U.S. Coast Guard required considerable overtime and further contributed to the budget increase. (See page 149 for a discussion of how outside agencies affected this project.)

Other Viaduct Repairs. The element "Other Viaduct Repair" consists of one project, the Atlantic Avenue Viaduct. The project includes inspection, design and repair or replacement of the steel superstructure and will extend into the proposed third Capital Program before a state of good repair is fully achieved. This project had significant budget increases due to changes in scope and different estimates about how repair work would be performed. (For a full discussion of the causes of the budget increase and project delay see page 134.)

A project for repairs on the Atlantic-Montauk Branch was dropped after 1987 because the LIRR decided that funds could be better used for other projects. However, this project has been proposed for the 1992-96 Capital Program.

Atlantic Branch Interlocking/Replace 25 Hz Power with 60 Hz. The Interlocking element is composed of one project to convert the Brook Tower to an all-relay interlocking that will allow remote control of the functions of the existing East New York and Van interlockings.

The power element is also composed of one project. Con Edison is phasing out 25 Hz electrical power in favor of 60 Hz and the LIRR must install 60 Hz feeder services at several locations. Both projects had to be stopped because asbestos was found in the manholes and the underground ducts from Jamaica Station to the Flatbush Avenue Terminal.

The Atlantic Branch Interlocking project started on schedule in 1987. In May 1988, while installing electrical cable in ducts and manhole tunnels, workers found debris believed to be asbestos. In March 1989, LIRR management stopped work in manholes and ducts for both projects.

In December 1989, the LIRR hired Laboratory Testing Service (LTS) to inspect and determine the nature of the asbestos problem. In March 1990, LTS reported that the asbestos problem was extensive. The LIRR was now faced with a project whose original estimate of \$6 million could reach \$20 million because of the cost of removing the asbestos.

The LIRR limited the project to hiring consultants to develop an abatement plan to remove asbestos in 67 manholes and ducts. The cost of actually removing the asbestos and completing the rest of the project was deferred to the 1992-96 Capital Program.

Completing the replacement of 25 Hz power with 60 Hz electricity also depends on installing electrical cables in the ducts and manholes. The LIRR will complete tasks that are not affected by the asbestos, such as replacing sump pumps, signal lighting and transformers.

Because of the asbestos problem, both projects are delayed. The Atlantic Interlocking was supposed to be finished in December 1989; the current scope of work is now expected to be finished in December 1992. The power project was supposed to be completed in July 1991; the LIRR expects it to be finished in June 1992.

Penn Station Infrastructure Improvements. This project's original scope included replacing or restoring vital infrastructure components in East River tunnels and Penn Station: rehabilitating track, providing a backup electrical supply for sump pumps and lighting, repairing bench wall structures, rehabilitating and restoring electrical, mechanical, and ventilating equipment, and reconditioning or replacing communications and signal equipment.

In 1989, the LIRR reduced the original \$17.9 million budget by \$4.2 million, using the \$4.2 million for other projects. Track rehabilitation work was reduced and some tasks were transferred to the Penn Station Central Control project. In 1990, the LIRR added \$1.4 million and in 1991 \$4.5 million was added to resurface platforms and stairways and to install clocks and lighting. By September 1991 the project had reached \$24.3 million. The railroad expects most work to be finished by late 1991; switch work should be done by 1992.

Proposed 1992-96 Capital Program

The proposed 1992-96 line structures program budgets \$113.6 million to rehabilitate bridges, tunnels, and viaducts. The LIRR plans to reinstate the rehabilitation of the Montauk Viaduct (\$12.2 million) and to continue work on the Atlantic Avenue Viaduct (\$30 million). Tunnel rehabilitation, which, under the 1987-91 Capital Program was budgeted at less than \$50,000, has been

increased to \$30.3 million under the proposed 1992-96 Capital Program. Bridge repair consists of two projects: systemwide bridge repairs (\$38.4 million); and repairs to a single bridge located on the Montauk Branch (\$2.7 million).

Improving the Jamaica Station Complex will be completed under a new project transferred to the stations category. However, the scope and budget of the project are much less than what was planned under the 1987-91 Capital Program. Completing the Atlantic Branch Interlocking improvements has been reclassified to the track category.

Progress Toward a State of Good Repair

The LIRR needs to make major investments over the next two decades to bring its bridges, viaducts and tunnels to a state of good repair. As of April 1991, the railroad expected to achieve this status in 2011.

SIGNALS AND COMMUNICATIONS

Prior to 1982, the LIRR had approximately 347 track miles of automatic block signalling which had been installed from the late 1930s to 1980. The optimal form of signalling consists of centralized traffic control with cab signalling and automatic speed control. This type of system controls trains on any track in either direction, with signal information shown in the cab of the train. Automatic speed control stops a train if the maximum speed permitted by a signal is exceeded.

In late 1980, the LIRR had several signal and communication modernization programs underway. Centralized traffic control, cab signalling and automatic speed control were being installed on several portions of the system as was new communications cable.

1982-86 Capital Program

In 1981, the LIRR budgeted \$28.5 million for upgrading its signals (see Table 67). By the conclusion of the 1982-86 program, \$51.4 million had been committed, an increase of \$22.9 million (80 percent). The increase resulted from new projects being added to the program in 1983.

TABLE 67: 1982-91 LIRR Signals and Communications Program
(\$ in millions)

| <u>Period</u> | <u>Commitments</u> | | <u>Change</u> | |
|---------------|--------------------------|-------------------------------|---------------|----------------|
| | <u>Original Plan</u> | <u>Current Projection</u> | <u>Amount</u> | <u>Percent</u> |
| 1982-86 | \$ 28.5 | \$ 51.4 | \$22.9 | 80 |
| 1987-91 | 189.0 | 199.1 | 10.1 | 5 |

Source: September 1981 and March 1987 Capital Plans; December 1990 Proposed Capital Plan Amendment

In 1981 the LIRR focused on upgrading the signal system on the 11.2 miles of track between Jamaica and Penn Station. Installing reverse signalling and automatic speed control was intended to eliminate delays by allowing trains to operate against the normal flow of traffic. The antiquated Harold Interlocking, built in 1910, was also planned for a major redesign to eliminate time-consuming train movements. Signal improvements on the Montauk Branch were also proposed.

In 1983, the railroad expanded its signals and communications program by adding projects between Jamaica and Penn Station, for reverse signalling on the Port Washington and Port Jefferson branches, and for several other smaller projects.

The LIRR completed two major projects during the 1982-86 program: reverse signalling and two new interlockings were installed on the Port Washington Branch and a new microwave system was set up to provide data link and increased voice communications between Jamaica, Hicksville, and Woodbury. Work on the Jamaica to Penn Station reverse signalling project, begun in the 1982-86 program, continued into the second Capital Program.

1987-91 Capital Program

In 1987, the LIRR budgeted \$189 million for signals and communications projects (see Table 68). In December 1990, the LIRR expected that its total commitments for this program would total \$199.1 million, a \$10.1 million increase (5 percent). Although the total budget rose only slightly from 1987 to 1991, the elements within the signals and communications category show significant budget variances. Our review found that these variances were caused by poor cost estimates, cost overruns due to changes in scope and dropping a project from the program.

TABLE 68: 1987-91 LIRR Signals and Communications Elements
(\$ in millions)

| Element | Commitments | | Change | |
|--|-----------------|--------------------|----------------|-------------|
| | Original Plan | Current Projection | Amount | Percent |
| Jamaica to Penn Station Reverse Signalling | \$ 136.4 | \$ 157.6 | \$ 21.2 | 16 |
| Reverse Signalling: Port Washington | .1 | .1 | .0 | 0 |
| Other Signal and Communication Improvements | 10.3 | 13.0 | 2.7 | 26 |
| Train Information System | 8.8 | 6.6 | -2.2 | -25 |
| Signal Improvement: Huntington to Port Jefferson | 13.9 | 21.7 | 7.8 | -56 |
| Hall to Valley Reverse Signalling | <u>19.6</u> | <u>0.0</u> | <u>-19.6</u> | <u>-100</u> |
| Total | <u>\$ 189.0</u> | <u>\$ 199.1</u> | <u>\$ 10.1</u> | <u>5</u> |

Source: March 1987 Capital Plan; December 1990 Proposed Capital Plan Amendment

The Jamaica to Penn Station reverse signalling project also included major improvements to the Harold and several other interlockings. This project rose from \$63 million in 1987 to \$96 million in 1990 and accounts for most of the element's increase. As originally planned, the Harold interlocking work would have taken five to six years to complete. Instead, the LIRR opted to concentrate work during a nine-week period from June to August 1990. Massive amounts of overtime were incurred as work was performed nonstop, except for rush hours, seven days a week. The railroad also had to reimburse the TA for providing LIRR passengers with alternate transportation during service interruptions.

Three projects within the Other Signal and Communication Improvements element experienced significant changes. First, the project to expand microwave communication links rose from \$3.6 million in 1987 to \$5.0 million in 1991 and also fell behind schedule. The budget increased for several reasons: bids came in higher than expected; additional surveys and inspections were needed; and new locations had to be found for some facilities due to soil

conditions at the original sites. Opposition to placing microwave towers in certain communities also contributed to project delay. Design was expected to be finished in December 1988, but was actually completed in February 1991. Construction is now estimated to be finished in December 1991.

Second, the replacement of the Engineering Department's radio system also increased in cost, rising from \$860,000 in 1987 to \$1.5 million in 1991. The project manager stated that the LIRR had underestimated the replacement cost primarily because railroad personnel were not familiar with the cost of this type of equipment.

The radio project was also seriously delayed. While installation was scheduled to start in April 1988, it did not actually begin until May 1991. After the LIRR realized the cost estimate was too low, the project was deferred until its scope could be revised and a new budget estimate could be calculated.

Third, new microprocessor equipment which was to be tested at the Garden Interlocking was not installed as planned. The 1987 Capital Plan budgeted \$2.2 million for this project, but no money was ever spent. The project is being redeveloped and the LIRR plans to begin design in December 1991. The project is included in the 1987-91 Capital Program with a budget of \$2.9 million.

The train information system (TIMACS) budget was reduced from \$8.8 million to \$4.9 million over the five-year program for two reasons. First, instead of purchasing two new computers as planned, the LIRR decided it could use a computer with excess capacity and thus was able to scale back the project's scope and save money. Second, a portion of the project devoted to another computerized system was transferred to the signal improvement project for the Port Jefferson Branch.

The TIMACS project is expected to be delayed 15 months. Work was halted in early 1989 when the MTA Board required that all projects of this type receive the explicit approval of the Finance Committee. After the railroad's presentation, the MTA Board reapproved the project in November 1990. Work is expected to start again in August 1991.

Signal improvements from Huntington to Port Jefferson, originally budgeted at \$13.9 million, rose to \$21.7 million by 1991. This \$7.8 million increase (56 percent) is due to several factors: the LIRR installed its own electric poles after it found it was not practical to use existing utility poles; the LIRR choose a more expensive method to install underground cable than originally planned because it caused less damage to roads; and, as discussed earlier, an additional project was transferred from the TIMACS project.

Finally, the railroad decided not to install reverse signalling from near Jamaica (Hall Interlocking) to Valley Stream. The LIRR cancelled this \$19.6 million project when it reduced the scope of the Jamaica Station Complex project. After studying the proposed Jamaica express tracks, it was decided that reverse signalling would not offer benefits substantial enough to justify the cost.

Proposed 1992-96 Capital Program

The LIRR proposes spending \$110.0 million for signals and communications projects during its proposed 1992-96 Capital Program. The program emphasizes replacing equipment that is nearing the end of its useful life and installing

additional reverse signalling on the Montauk Branch. New switch mechanisms and a new control system are proposed for the Port Washington Branch to allow for remote control from Jamaica. The LIRR also plans to design new towers to replace the existing Queens and Valley Towers and to convert portions of its Main Line and Port Jefferson Branch from electronic track circuits to more reliable 100-cycle AC track circuits.

Progress Toward a State of Good Repair

The LIRR expects its signal and communication systems to attain a state of good repair in 1991.

SHOPS AND YARDS

Many of the railroad's shop facilities for maintaining electric and diesel hauled cars were constructed before 1900. For example, the Morris Park Shops, constructed in the 1890s, served as the locomotive inspection and repair facility and the main shop for electric commuter cars. Diesel cars were serviced outdoors at Richmond Hill for lack of an enclosed facility.

In 1980, the LIRR proposed a major ten-year program for upgrading and constructing maintenance facilities. At that time, a consultant was identifying the LIRR's shop needs and developing a Mechanical Facilities Master Plan. The railroad envisioned constructing a new electric car shop at Morris Park, a new diesel car facility at Richmond Hill, a new electric and diesel car cleaning facility at a yard in Brooklyn, an enclosed car wash in Jamaica, and a general modernization of shop equipment and facilities.

1982-86 Capital Program

In 1981, LIRR budgeted \$159 million for its shops and yards (see Table 69). By the conclusion of the 1982-86 program, \$536.4 million had been committed for this category, an increase of \$377.4 million (237 percent). The increase was primarily due to a significant change in the facilities plan and to large cost increases for several projects.

TABLE 69: 1982-91 LIRR Shops and Yards Program
(\$ in millions)

| <u>Period</u> | <u>Commitments</u> | | <u>Change</u> | |
|---------------|--------------------------|-------------------------------|---------------|----------------|
| | <u>Original Plan</u> | <u>Current Projection</u> | <u>Amount</u> | <u>Percent</u> |
| 1982-86 | \$ 159.0 | \$ 536.4 | \$ 377.4 | 237 |
| 1987-91 | 119.8 | 87.8 | -32.0 | -27 |

Source: September 1981 and March 1987 Capital Plans; December 1990 Proposed Capital Plan Amendment

In 1981, the LIRR wanted to build a modern shop complex to maintain both diesel and electric cars. Noting that its shops could not handle the existing car fleet and that it planned to purchase 216 new cars, the railroad proposed \$101 million for Richmond Hill, the Morris Park Shop and a new electric car shop. The plan also provided \$58 million to construct a new West Side Storage Yard adjacent to Penn Station to eliminate moving empty trains as far east as Babylon for mid-day storage. By 1987, the storage yard project had increased to \$196 million.

In June 1982, the LIRR declared that "significant developments had taken place" leading to a revised facilities master plan. These new factors included the availability of larger areas of the Hillside Yard and a warehouse facility adjacent to the Hillside Yard, and a need to relocate electric car lay-up facilities within the Jamaica area. The LIRR revised its Master Plan "from an eleven phase project incorporating segregated equipment maintenance facilities into a seven phase program which ... will provide a consolidated, fully integrated electric and diesel equipment maintenance facility."

The LIRR completed several major projects under its 1982-86 program. A new shop building was constructed at Richmond Hill in 1983 and the first phase of modernizing the yard facilities was also completed. The West Side Storage Yard was completed in June 1987 and a new freight facility was built at Long Island City to house the railroad's Freight Department.

The largest undertaking in the entire LIRR Capital Program was the Hillside Maintenance Complex and Support facility. Commitments to the Hillside project grew tremendously. Budgeted at approximately \$171 million in 1983, the Hillside Complex budget stood at \$319 million by the end of the 1982-86 Capital Program. Work on the complex carried over into the next Capital Program.

1987-91 Capital Program

In 1987 the LIRR budgeted \$119.8 million for continuing work on Hillside and for several new shops and yards projects. As of December 1990, the railroad expected to commit \$87.8 million for this category, a decrease of \$32 million (27 percent). Funds for two projects were transferred to other capital projects and the allocation for shop improvements to Hillside and Richmond Hill was reduced by \$11.5 million. These decreases were partially offset by a \$7.8 million increase to buy land near the West Side Storage Yard. Major transfers from deferred or downscoped projects funded overruns in the Hillside Facility accrued during the 1982-86 programs.

The 1987-91 shops and yards category includes five major projects:

1. Electrical Car/Truck Shop at Hillside (Phase I)
2. Hillside Maintenance Phase II
3. Richmond Hill Yard Improvement
4. West Side Storage Yard
5. Port Jefferson Yard Improvement

Work on the Hillside Maintenance Complex was divided into two phases: Hillside phases I and II. Hillside Phase I began in 1983, focused on designing and constructing an Electric Car Shop, an undercar cleaning and wheel truing facility, an automated storage and retrieval system (ASRS), and communication and signal systems. In 1987, the entire \$240 million budget for Phase I was amended to \$260.2 million, up \$20.2 million to cover additional costs related to the ASRS system, increased claims reserve and insurance.

In 1988, the budget was increased \$22.6 million to \$282.2 million to reflect the prior underestimation of appropriate budget contingencies to complete heavy construction work and the underestimation of contracts remaining to be awarded at the preliminary engineering stage (pre-1989). In 1989, the budget was increased \$15.8 million to \$298.6 million to permit construction to continue despite the 1987 default of the project's general contractor. After the LIRR's review of all ongoing capital projects in 1989, the Hillside facility was increased \$56.6 million to \$355.2 million to reflect the costs of railroad project and construction management personnel. Most of these increases were allocated to the first Capital Program and are not shown in the shops budget for 1987-91.

Hillside Phase II involved modifying the existing Maintenance-of-Way Repair Facility, constructing an equipment and material storage area/fueling facility, installing shop equipment and storage racks, constructing a central kitchen with satellite cafeterias, building track crossings and pedestrian walkways in the lay-up yard, and procuring four automated guided vehicles. From 1987 to 1990, the project's 1987 budget of \$38.7 million decreased by \$1.1 million. Several items including robotics, shop equipment and an energy management system were deleted, and a computer system was added. As of September 1991, the total budget for Hillside was \$380.6 million, \$348.7 for Phase I and \$31.9 million for Phase II.

The Richmond Hill Yard Improvement project is one of five projects that the LIRR placed in the reserve category to ensure that funds would be available for the project. The original scope included removing track and contaminated soil, replacing switches and upgrading storage capacity, and installing maintenance support systems such as water and air lines. As a result of cost increases, particularly for tasks needed to meet New York State Department of Environmental Conservation (DEC) regulations, the project was deferred. In 1990, its \$12.2 million budget was disbursed to projects with higher priorities. However, in May 1991 the LIRR restored this project to its 1991 program because funds became available and railroad management decided that it was still a priority project.

The LIRR increased the West Side Storage Yard's total budget from \$196 million to \$203.5 million to acquire property adjacent to the yard. MTA directed the railroad to purchase real estate should the need arise to expand the West Side Yard.

The Port Jefferson Yard Improvement project was added to the program in February 1989. Originally, a station project was to include installing new fuel tanks at the Port Jefferson Yard. However, this plan had to be revised after DEC required double-walled underground fuel tanks. This increased the cost for this project and the railroad transferred \$5.3 million from the stations to the shops and yards category. This project was finished in June 1990 at a cost of \$4.3 million.

The LIRR dropped two projects from its 1987-91 shops and yards program. The Bridges and Building Shop Design project (budgeted at \$10.5 million) and the Long Island City Yard Storage and Maintenance Improvements project (budgeted at \$18.7 million) were considered low priority projects. In 1988, after a review by railroad management, funds were transferred to other higher property projects. (For a discussion of the LIRR's reprioritization of capital projects and capital budget transfers see page 142.)

Proposed 1992-96 Capital Program

The LIRR proposes spending \$38.3 million to continue upgrading its shops and yards. The railroad also wants to rehabilitate the car wash at the Richmond Hill Yard to meet water conservation and environmental mandates.

The LIRR plans to comply with environmental and safety regulations which necessitate removing contaminated soil from one yard and removing underground oil storage tanks at five sites. Other proposed projects include replacing the outdated steam heating plant at Morris Park with gas heaters, completing preliminary engineering and design of a new Morris Park Locomotive Shop and associated diesel support, and rehabilitating or replacing employee welfare facilities at nine locations.

Progress Toward a State of Good Repair

The LIRR expects that its shops and yards will attain a state of good repair by 1991 when the Hillside Facility opens.

ELECTRIFICATION/EXTENSIONS

Extending electric service was intended to enable more riders to arrive at their destinations without having to transfer en route. In 1970, electrification was extended to Huntington on the Port Jefferson Branch in what was to be a first step in a phased electrification project for the entire branch. In the following decade, the diesel/electric transfer at Huntington proved to be time-consuming and inconvenient for passengers. To solve this problem, the LIRR planned to extend electric train service beyond Huntington.

1982-86 Capital Program

In 1981, the LIRR budgeted \$35.7 million for electrification and extensions (see Table 70). By the end of the first Capital Program, \$176.6 had been committed, an increase of \$140.9 million (395 percent). The large increase came primarily from transferring funds from the track category and adding funds for new electrification work.

The LIRR originally planned to extend electric service and install reverse signalling on the Port Jefferson Branch between Huntington and Northport. This project also called for three new platforms, including ramps, overpasses, canopies, shelters and station lighting.

TABLE 70: 1982-91 LIRR Electrification Program
(\$ in millions)

| Period | Commitments | | Change | |
|---------|------------------|-----------------------|----------|---------|
| | Original Plan | Current Projection | Amount | Percent |
| 1982-82 | \$ 35.7 | \$ 176.6 | \$ 140.9 | 395 |
| 1987-91 | 130.6 | 62.5 | -68.1 | -52 |

Source: September 1981 and March 1987 Capital Plans; December 1990 Proposed Capital Plan Amendment

The 1981 electrification program was revised in 1982 and 1983. In 1982, the railroad transferred funds from its track program to fund double tracking from Syosset to Northport. This transfer brought the 1982 budget to \$63.1 million. In 1982, the LIRR also reviewed its track capacity needs and proposed to "augment" the single track configuration on the 17-mile track segment between Republic and Ronkonkoma on the Main Line. The railroad also proposed constructing and electrifying a second main line track from Syosset to Huntington and planned to study the remainder of the Port Jefferson Branch.

In 1983, more revisions were made and new funds were added bringing total funding to \$168.1 million. Added projects included the electrification of the Main Line from Hicksville to Ronkonkoma and track and electrification improvements on the Port Jefferson Branch.

Under its 1982-86 Capital Program, the LIRR extended Main Line electrification on the 23.5-mile section from Hicksville to Ronkonkoma. In addition, a 10-track yard and employee support facility was built at Ronkonkoma Yard, a second main electrified track on the Port Jefferson Branch between near Syosset and Huntington was completed, and new overpasses and platforms at two stations were built.

1987-91 Capital Program

In 1987, the LIRR budgeted \$130.6 million for electrification, but by December 1990, it estimated that it would commit only \$62.5 million (52 percent). The budget was reduced because \$25.8 million for reserves for advance engineering and for new projects were transferred to another category and because the scope of the Main Line Third Track project was reduced by almost \$37 million.

By 1987, planned electrification projects on the Port Jefferson Branch were substantially completed. Improvements were complete along the line from Syosset to Huntington and from Huntington to Northport. Improvements east of Northport were completed by February 1989, as was the Main Line electrification from Hicksville to Ronkonkoma, including the construction of the Ronkonkoma Yard.

The LIRR's electrification policy changed during the 1987-91 Capital Program. Even though additional electrification would improve service, the railroad believed that adequate service could be provided with existing diesel powered lines and that dual-mode locomotives might provide a cost effective alternative if tests prove successful. Project managers stated that projects in other categories are considered more important, and that it makes sense to spend funds originally committed to electrification on them.

Although the railroad plans no additional electrification work, two projects were added to this program category. In 1989, the Third Track Design Construction Mineola project (\$49 million) was added because the New York State Department of Transportation and Nassau County decided to eliminate six dangerous grade crossings in the Mineola area. The LIRR will build a third track at these locations to prepare for future third track expansion from Bellrose to Hicksville. The Ronkonkoma Noise Mitigation project (\$3.0 million) was added because of community outcry over the noise coming from the new service yard.

The LIRR does not plan any electrification work in the 1992-96 Capital Program. The Ronkonkoma noise mitigation project is expected to be completed in 1992, and the Mineola third track project is planned for completion in 1996.

METRO-NORTH COMMUTER RAILROAD

OVERVIEW

The MTA's 1980 assessment of the Metro-North* system found much of its physical plant and rolling stock to be overaged and badly deteriorated from a lack of basic maintenance over many years. Among the worst parts of the system were its antiquated shops, some built in the early 1900s, which hampered car maintenance. Many of the locomotives being used were old and unreliable, and inadequate shop facilities compounded the maintenance problem.

The railroad's infrastructure also demanded attention. Switch and signal failures, and an obsolete power supply, contributed to train delays. The railroad's bridges, tunnels, and viaducts required repairs, rehabilitation, or replacement. While station conditions varied greatly, a 1983 survey found that many of them were inadequate. Some could be repaired but the old wooden platforms at others had to be replaced.

Metro-North planned to spend almost \$1.7 billion between 1982 and 1991 to rebuild its physical plant and thus accommodate increased ridership (see Table 71). While nearly equal amounts were spent in each of the two five-year Capital Programs, Metro-North shifted its focus in the 1987-91 Capital Program as can be seen in the different proportions of funds spent on each program category.

TABLE 71: 1982-91 Metro-North Capital Program
(\$ in millions)

| Category | Planned Commitments | | | | Total | |
|--------------------------|---------------------|-------|----------|-------|------------|-------|
| | 1982-86 | | 1987-91 | | 1982-91 | |
| | Amount | Pct. | Amount | Pct. | Amount | Pct. |
| Rolling Stock | \$ 232.6 | 27.0 | \$ 124.7 | 15.5 | \$ 357.3 | 21.4 |
| Passenger Stations | 52.2 | 6.1 | 260.5 | 32.3 | 312.7 | 18.7 |
| Line Structures | 155.5 | 18.0 | 183.0 | 22.7 | 338.5 | 20.3 |
| Signals & Communications | 76.9 | 8.9 | 53.9 | 6.7 | 130.8 | 7.8 |
| Power | 195.3 | 22.6 | 84.6 | 10.5 | 279.8 | 16.8 |
| Shops & Yards | 86.3 | 10.0 | 74.1 | 9.2 | 160.5 | 9.6 |
| Electrification | 63.6 | 7.4 | .0 | 0.0 | 63.6 | 3.8 |
| Miscellaneous | .2 | 0.0 | 26.2 | 3.2 | 26.4 | 1.6 |
| Total | \$ 862.5 | 100.0 | \$ 807.1 | 100.0 | \$ 1,669.6 | 100.0 |

Source: December 1990 Proposed Capital Plan Amendment

* Metro-North was created in January 1983 when Congress forced Conrail to divest itself of passenger operations. Prior to that passenger service on the Hudson, Harlem and New Haven lines was operated by Conrail.

In the 1982-86 Capital Program, Metro-North focused on bringing much of its car fleet, line structures, signals, tracks, and power system to a state of good repair. Rolling stock purchases under the first Capital Program included 142 M-3a electric cars, 54 M-4 electric cars and 57 diesel-hauled coaches. The railroad began rehabilitating the Park Avenue Tunnel leading to Grand Central Terminal by repairing the tunnel structure and replacing much of its track. Track and signal improvements costing almost \$100 million brought Metro-North's track to a state of good repair and provided cab signaling and automatic speed control for most of the system. Metro-North constructed 35 new substations on the Hudson and Harlem lines and replaced 170 miles of third rail. New maintenance shops were built at Brewster and North White Plains and the Harmon Shop was extensively rehabilitated.

The 1987-91 Capital Program continued Metro-North's efforts to rehabilitate its system, but emphasis changed from rolling stock and power to stations and line structures. Of the total \$807 million for the Capital Program, \$482 million (60 percent) was for work to bring the system to a state of good repair. The railroad provided over \$100 million to bring its outlying stations to a state of good repair and provided nearly \$120 million for projects to improve Grand Central Terminal's infrastructure and its train yard. In addition, efforts continued to bring track, roadbed and right-of-way to a state of good repair and establish normal cycles of maintenance to keep them in good repair. Upgrading the power system focused on replacing outdated equipment on the New York portion of the New Haven Line's overhead catenary system.

With just a few exceptions, Metro-North completed its projects on schedule and within budget. Some projects were deferred, though, and a few experienced delays, cost overruns, or both. Causes included faulty engineering surveys and designs, changes in scope due to unforeseen site conditions, and outside factors, such as government agencies and community groups. Listed below are the major observations of our review of each of Metro-North's Capital Program categories.

- Although Metro-North's purchase of new cars and locomotives during the 1982-91 period has been relatively trouble-free, the dual-mode locomotive project experienced major problems. Due in part to the small number of bidders for the job, the contract was awarded a year late. Since then, delays have increased. Five prototype locomotives were supposed to be completed by June 1990, but they are not expected until October 1991, 16 months late. O'Brien-Kreitzberg attributes these delays to inadequate designs and poor management and supervision.
- Metro-North generally met its goals for passenger stations, but several projects were deferred or delayed.
 - o Metro-North's plan to build a new Yankee Stadium Station was postponed because the Yankees and the City of New York did not complete a long-term lease.
 - o The railroad deferred the \$73 million Grand Central Terminal North End Access project because of problems coordinating financing with other government agencies and private businesses. Negotiations, however, are continuing.
 - o Metro-North put off the planned purchase of ticket vending machines until a fare collection study is completed.

- o Because of legal and political problems with municipalities over their share of matching funds, Metro-North expanded parking at only seven of the 14 locations where it had originally hoped to complete parking projects. To compensate, four more parking projects were initiated in 1990.
- The railroad's line structure improvements have generally been completed as planned. There have, however, been exceptions.
 - o Improving interlockings experienced a nine-month delay because the type of equipment was changed and this scope revision triggered problems with the "Buy America" law. Reconfiguring the Mott Haven Interlocking cost \$5 million more than planned because engineering tests found that more work would be required. Waiting for UMTA to approve additional Federal funds might delay the project as long as a year.
 - o Rehabilitating the New Hamburg Bridge was put on hold when the U.S. Coast Guard declared that the waterway required a drawbridge rather than a non-movable bridge. Future work is now dependent on the passage of a bill in Congress.
 - o The Park Avenue Tunnel, Metro-North's largest single line structure project, was delayed 10 months when the discovery of wood pilings led to a change in the design of the tunnel's concrete roof. Also contributing to the delay were defective concrete ties which Metro-North had to replace.
 - o Repairing the railroad's bridges will cost considerably more than anticipated due to unexpectedly severe deterioration. This led to extensive design changes and concomitant delays. Inadequate surveys of bridge conditions led to this problem.
- Metro-North's signals and communications projects were, or will be, completed on time and within budget with two exceptions:
 - o The Grand Central Terminal Signals, Interlock, and Track project rose 30 percent, from \$31.2 million to \$40.6 million. Of the total \$9.4 million increase, \$7 million was for upgrading Grand Central Terminal's switches. Increases in force account, spare parts, and engineering work made up the balance.
 - o A project to install car signaling from Mott Haven to 57th Street may be delayed up to one year due to problems completing track work in the area. Consequently, the signal and track work could not be coordinated as planned.
- The New Haven Line catenary project experienced a one-year delay and significant budget increase. The budget rose from \$35.1 million to \$47.3 million (34 percent) after design was completed due to revised construction and staging plans, increased labor and material requirements, and addition of structural work to the project's scope. The delay was due to the time it took to approve additional funds.

- o As a result of the delay, Metro-North deferred replacing four Anchor Bridge substations on the New Haven Line until the 1992-96 Capital Program. The new substations are not required until the catenary work is completed and the deferral freed up funds for the catenary project.

-- Metro-North completed most of its shop and yard projects on schedule and within budget. DEC's involvement with the railroad's shops and yards projects contributed to some delay when Metro-North redesigned project scopes to meet environmental requirements or delayed construction until DEC approved project designs (see page 148).

ROLLING STOCK

When Metro-North took over operations from Conrail, its car fleet was unable to handle the ridership on all three lines and some of its fleet was beyond its useful life.

1982-86 Capital Program

The 1981 Capital Plan called for Metro-North to purchase almost 200 new cars, to rebuild 24 others and to perform other miscellaneous work. Over \$277 million was earmarked for this purpose. By the end of 1986, \$232.6 million had actually been committed and most of Metro-North's goals for improving its rolling stock had been achieved (see Table 72).

TABLE 72: 1982-91 Metro-North Rolling Stock Program
(\$ in millions)

| Period | Commitments | | Change | |
|---------|----------------|---------------------|----------|---------|
| | Original Plans | Current Projections | Amount | Percent |
| 1982-86 | \$ 277.5 | \$ 232.6 | -\$ 44.9 | -16 |
| 1987-91 | 118.7 | 124.7 | 6.0 | 5 |

Source: September 1981 and March 1987 Capital Plans; December 1990 Proposed Capital Plan Amendment

Metro-North purchased 142 M-3a cars for its Harlem and Hudson Lines and ten self-propelled diesel cars to replace aging equipment on the Upper Hudson Line. It also purchased 54 M-4 cars for the New Haven Line. It had planned to purchase 44 M-2 cars, but needed additional cars to accommodate growing ridership. M-4 cars, rather than M-2 cars were purchased because they were a newer, better model. Finally, the railroad equipped seven of its FL-9 locomotives with head-end power for use with Upper Hudson coaches.

In August 1983, \$21 million was added to Metro-North's rolling stock budget to purchase seven locomotives (\$18 million) and rebuild rail-diesel cars (\$3 million). Rather than rebuilding the diesel cars, though, the railroad purchased ten new coaches for West of Hudson service* and 27 new coaches for Hudson Line service north of Croton-Harmon. Metro-North found that purchasing new coaches would be cost-effective.

1987-91 Capital Program

The second Capital Program budgeted \$118.7 million for rolling stock. As of December 1990, Metro-North expected to commit \$124.7 million, a \$6 million (5 percent) increase from the original budget (see Table 72).

The 1987-91 Capital Program focused on buying additional cars and locomotives to keep up with growing ridership. Metro-North has met its 1987-91 goals except for the dual-mode locomotive project, which has experienced extensive delays. (See page 111 for a discussion of this project and the causes of delay.)

The 1987 Capital Plan proposed purchasing four new locomotives for West of Hudson service. This contract was completed and the locomotives were put into service. For its Upper Hudson Line, Metro-North planned to purchase 13 diesel coaches and remanufacture an additional five dual-mode locomotives. The 13 coaches were placed in service, but the dual-mode locomotives were deferred until the prototype dual-mode project could be assessed.

The 1987 plan called for purchasing 60 new M-4 cars for its New Haven Line to accommodate anticipated growth in ridership. Metro-North continued with this plan in its May 1988 capital program, but the February 1989 plan amendment revised this project to 48 new cars: 18 to be purchased by the MTA and 30 by the Connecticut Department of Transportation. This project was included in the December 1990 plan amendment, but instead of M-4 cars, Metro-North planned to purchase 48 M-6 electric cars. These changes were due to the same factors discussed earlier regarding the proposed purchase of M-2 cars: a reassessment of fleet requirements and purchase of improved models.

There were also several small rolling stock projects in the 1987-1991 program. These included:

- o installation of standby power at Poughkeepsie.
- o design and engineering of new electric cars for the Harlem and Hudson lines.
- o annual Maintenance-of-Way equipment purchases.
- o two rebuilt locomotives and two coaches for West of Hudson service.

* Under contracts with New Jersey Transit, Metro-North provides service west of the Hudson River, in Orange and Rockland Counties, on the New York State portions of the Hoboken to Port Jervis and Pascack Valley lines.

- o eight coaches for East of Hudson service.
- o conversion of ten self-propelled coaches into push-pull coaches for East of Hudson service.

All of these small projects progressed as planned and were within schedule and budget, with the exception of the conversion of the ten self-propelled coaches. This project would have been too costly according to the preliminary design estimates and the conversion project has been deferred.

Delay in Acquiring the Dual-Mode Locomotives

The dual-mode locomotive project involves extensive modifications to ten Metro-North FL-9 locomotives to enable them to operate under either diesel or electric power. This 1987-91 Capital Program project has been delayed due to Asea Brown Boveri's (ABB) poor design work and project management. Of the ten locomotives, five were prototypes and five were to be production units. While Metro-North is managing the project, three of the prototypes are for the LIRR. ABB is designing the locomotives and Republic Locomotive Works (RLW) is assembling them.

The dual-mode locomotive project experienced delays since its inception. It was conceived in late 1984 and Metro-North expected to award a contract in 1986. The design contract was awarded in 1987 approximately one year behind schedule, due to the complexity of the job and the small number of responsive bidders.

This project continues to be delayed. The prototypes were originally scheduled to be delivered by June 1990. The current anticipated date is October 1991, 16 months behind schedule. The MTA's consulting engineer, O'Brien - Kreitzberg, attributed the delays to ABB's inadequate performance. The project suffered from poor scheduling, poor performance analysis and planning, bad management decisions, non-conformance with mandated quality control procedures, numerous changes in ABB's management, and ABB's inability to prepare adequate designs and supervise RLW's work.

The project has increased in cost from \$58.5 million to \$64.9 million.* According to Metro-North's Deputy Director of Equipment, most of this budget increase is due to changes in scope and specifications for the LIRR prototypes so that they can operate with new LIRR bi-level coaches. The remainder of the budget increase is for additional costs for support staff and consultant services.

Metro-North has notified ABB of its intent to assess liquidated damages for the delay. These payments are to be made at the end of the contract when all funds are dispersed. While delay on Metro-North appears to be limited to temporary monetary losses, its effect on the LIRR is more serious. The LIRR planned to use its dual-mode locomotive prototypes to propel ten new bi-level coaches. ABB's failure to deliver the locomotives on time has forced the LIRR to use two modified locomotives from Chicago or modified Metro-North locomotives for testing the new coaches. In addition, the LIRR has had cost increases because of the dual-mode locomotives' delay. In 1991, the budget for the bi-level coaches rose from \$31.6 million to \$40.6 million.

* This \$6.4 million increase represents the total increase for both Metro-North and the LIRR.

Proposed 1992-96 Capital Program

Metro-North has proposed spending \$197.6 million for rolling stock in the proposed third Capital Program to continue replacing equipment at the end of its useful life and to accommodate ridership growth. The 1992-96 Capital Program begins a replacement process which will eventually add 60 cars to the fleet by the year 2000.

New electric cars are needed for the Hudson and Harlem lines to replace cars built in the early 1960s.* Nineteen additional cars are needed to serve anticipated ridership growth on the Harlem and Hudson lines. Metro-North plans to lengthen some trains to meet its passenger loading standards and schedule new trains to meet specific service demands. In addition, 24 diesel coaches and six locomotives are needed for East of Hudson service. For West of Hudson needs, four coaches and two diesel locomotives will be used to meet anticipated demand.

Other planned 1992-96 purchases include a diesel-electric switching locomotive, new maintenance-of-way rolling stock, two diesel-electric locomotives for maintenance purposes, a locomotive to replace one in the New Jersey Transit pool, and three box cars to replace old equipment.

Progress Toward a State of Good Repair

Metro-North's rolling stock has generally reached a state of good repair. With the completion of projects begun in the 1987-91 Capital Program, the railroad anticipates that its cars and locomotives will have achieved a state of good repair by 1992.

PASSENGER STATIONS

When it took over from Conrail in 1983, Metro-North became responsible for 79 stations with a total of 113 high-level and 53 low-level platforms. Some of these facilities were beyond their useful life and badly deteriorated. Furthermore, some were not accessible to the elderly and handicapped. In addition, many platforms were too short to accommodate trains then in service. This necessitated additional train staff and excessive dwell times, and led to unequal train loading. Some platforms constructed in 1970 consisted of creosoted timbers and asphalt, which require much maintenance and are a fire hazard.

This category includes projects for constructing new high level platforms, improving existing stations, rehabilitating Grand Central Terminal, reconstructing elevators, and building new stairways and waiting rooms.

1982-86 Capital Program

The first Capital Program budgeted \$23.3 million for stations (see Table 73). By the end of the 1982-86 program, Metro-North had committed \$52.2 million, a \$28.9 million (124 percent) increase. The increase was largely due to funds added in 1983 for improving mid-Harlem stations and for the Grand Central Terminal North End Access project.

* Metro-North's September 1991 proposal now calls for maintaining the ACMU 1100 Series cars currently in service on the Hudson and Harlem Lines.

TABLE 73: 1982-91 Metro-North Stations Program
(\$ in millions)

| <u>Period</u> | <u>Commitments</u> | | <u>Change</u> | |
|---------------|--------------------------|--------------------------------|---------------|----------------|
| | <u>Original Plan</u> | <u>Current Projections</u> | <u>Amount</u> | <u>Percent</u> |
| 1982-86 | \$ 23.3 | \$ 52.2 | \$ 28.9 | 124 |
| 1987-91 | 239.4 | 260.5 | 21.1 | 9 |

Source: September 1981 and March 1987 Capital Plans; December 1990 Proposed Capital Plan Amendment

Metro-North completed several major projects during the 1982-86 stations program. Improvements at Grand Central Terminal (GCT) included an improved passenger information system, roof and elevator rehabilitation, and installation of ticket vending machines. High-level platforms were constructed on the Upper Harlem Line and an improved North White Plains Station was completed. Five West of Hudson stations were improved as were the Yonkers, Tarrytown and Croton-Harmon stations. The North End Access design was completed in late 1986 as were the designs for the Mid-Harlem station improvements. Construction of these last two projects was scheduled for the 1987-1991 Capital Program. Construction on the mid-Harlem station project started in December 1987, but the North End Access project has been delayed due to funding problems.

1987-91 Capital Program

In March 1987, the 1987-91 Capital Program for stations was set at \$239.4 million. By 1991, projected commitments had risen to \$260.5 million, a \$21.1 million (9 percent) increase. This program category includes eight elements (see Table 74).

TABLE 74: 1987-91 Metro-North Station Elements
(\$ in millions)

| <u>Element</u> | <u>1987 Approved Plan</u> | <u>1991 Plan Amendment</u> | <u>\$ Variance from Plan</u> | <u>Pct. Variance from Plan</u> |
|------------------------------------|-------------------------------|--------------------------------|----------------------------------|------------------------------------|
| Miscellaneous Station Improvements | \$ 4.8 | \$ 5.9 | \$ 1.1 | 22.9 |
| GCT North End Access | 59.0 | 73.0 | 14.0 | 23.7 |
| Mid-Harlem Station Improvements | 34.1 | 35.7 | 1.6 | 4.7 |
| GCT Improvements | 56.8 | 57.6 | 0.8 | 1.4 |
| Outlying Station Improvements | 72.1 | 65.8 | -6.3 | -8.7 |
| Passenger Improvements | 2.8 | 1.3 | -1.5 | -53.6 |
| Ticket Sales and Fare Collection | 9.8 | 1.2 | -8.6 | -87.8 |
| Parking | <u>0.0</u> | <u>20.0</u> | <u>20.0</u> | <u>0.0</u> |
| Total | <u>\$ 239.4</u> | <u>\$ 260.5</u> | <u>\$ 21.1</u> | <u>8.8</u> |

Source: March 1987 Capital Plan and December 1990 Proposed Capital Program Amendment

1987-91 Project Deferrals and Delays

While Metro-North generally accomplished its station goals, several projects had problems which led to delays or to their deferral to the proposed 1992-96 Capital Program.

In 1988 an \$8 million project was added to the program to provide commuter rail service to Yankee Stadium from the northern suburbs, Connecticut, and Manhattan. The project was ultimately deferred because a long-term lease between the Yankees and the City of New York was not completed.

Metro-North had planned to begin construction on its GCT North End Access project in 1989, but work was not begun because the MTA Board did not approve it. Metro-North's legal staff and the MTA Real Estate Department are negotiating with other public agencies and businesses that will be contributing money to this project. Until these negotiations are completed, the project is on hold.

Several other projects were deferred to the proposed 1992-96 Capital Program: the Fordham Station Platform Extension, an overpass at Botanical Garden, and the purchase of ticket vending machines. Metro-North management deferred the first two projects because funds were inadequate and these projects were not a high priority. Metro-North officials want to complete a fare collection study before buying the ticket vending equipment.

Several projects were delayed. New Haven Line platform improvements were delayed six months while Metro-North waited for the New York State Department of Transportation to repair a bridge over the tracks. This held up work at the nearby Rye Station. In addition to the delay, \$98,000 in change orders resulted from DOT's bridge work. Work on the other seven New Haven Line stations in this project were completed on time in September 1989.

The parking program has been delayed because several communities declined to participate and several others have not decided whether they can finance their share. In other cases, legal problems such as parking fee rates must be resolved (see page 149).

We found that station projects were within or slightly under budget, with just one exception. The mid-Harlem Station Improvement project is approximately \$2 million over budget, but this is not a large variance (6 percent) for a \$35.7 million contract. Of the \$2 million increase, \$800,000 was for change orders, \$400,000 was for asbestos removal, and the balance was related to field conditions that arose during construction. A three-month delay also increased flagging, construction supervision, and force account costs.

Proposed 1992-96 Capital Program

For its proposed third Capital Program, Metro-North plans to spend \$245.6 million for station improvements. This is 23 percent of the program total and its largest single category. Most of the funds in this category, \$149.7 million (61 percent), are proposed for Grand Central Terminal to bring it to a state of good repair and to invest in system improvements contained in the GCT Master Plan.

The 125th Street Station will be improved by installing new concrete fireproof platforms and rehabilitating the viaduct structure supporting the platforms. Platform extensions will continue at Bronx stations on the Hudson and Harlem Lines including the deferred Fordham station. Metro-North hopes to construct 2,500 new spaces in its parking program between 1992 and 1996.

Funding is also proposed for: ticket vending machines at GCT and selected outlying stations; a Secaucus Transfer Station at the intersection of the Amtrak/NJ Transit Northeast Corridor and NJ Transit's Main Line; restoration of station canopies, resurfacing of platforms, rehabilitation of station roofs and heating systems, replacement of ticket office machines with newer equipment, and replacement of low-level platforms at four stations. The deferred Botanical Garden overpass project is also included in this program. Finally, Metro-North intends to construct elevators at key stations to provide access for the handicapped.

Progress Toward A State of Good Repair

Considerable additional work is still required to bring Metro-North's stations to a state of good repair. The railroad expects to reach this objective in 2006. Further rehabilitation of Grand Central Terminal's utilities

infrastructure still remains to be done. In addition, repair work is needed to restore station canopies, resurface station platforms, and rehabilitate station buildings, including the 125th Street Station.

LINE STRUCTURES

Metro-North's rail facilities include 27 track miles of tunnel and five track miles of elevated structures, including the Park Avenue Tunnel and Viaduct. These structures include underground and elevated structures, drawbridges, bridges, retaining walls, and drainage systems along railroad rights-of-way.

Water infiltration and poor drainage caused problems in the Park Avenue Tunnel. Exposure to this water, which often contains corrosive deicing salt, damages signal components and often causes third rail failures.

Because of a lack of funds for preventive maintenance, many bridges and elevated structures were maintained only on an as-needed basis. Consequently, steel continuously exposed to the weather required painting and some elevated structures needed replacement of support columns and steel troughs. Concrete bridge abutments, retaining walls and piers also required repair or replacement.

The line structures category also provides funds for upgrading interlockings, locations where tracks meet and diverge and where complex signal and switch configurations are necessary to prevent trains from making conflicting movements. Interlocking improvements are found in both the line structures and signals categories. Thus, some ancillary signal work will actually be done under line structures projects and some track work may be done as part of a larger signals project (e.g., the GCT signals, interlock and track project).

1982-86 Capital Program

The first Capital Program budgeted \$29.2 million for line structure work. By the end of the 1982-1986 program, \$155.5 million had been committed, an increase of \$126.3 million or 432 percent (see Table 75).

TABLE 75: 1982-91 Metro-North Line Structures Program
(\$ in millions)

| Period | Commitments | | Change | |
|---------|-------------------|------------------------|----------|---------|
| | Original Plans | Current Projections | Amount | Percent |
| 1982-86 | \$ 29.2 | \$ 155.5 | \$ 126.3 | 432.0 |
| 1987-91 | 165.1 | 183.0 | 17.9 | 10.8 |

Source: September 1981 and March 1987 Capital Plans; December 1990 Proposed Capital Plan Amendment

The 1981 Capital Plan provided \$29.2 million for improving interlockings and rehabilitating bridges, tunnels and track. Interlocking improvements were planned between Spuyten Duyvil and Croton River Bridge and at Harmon, Brewster, North White Plains, Mott Haven, Shell and Pike interlockings. The bridge and tunnel improvement program was for correcting the effects of many years of deferred maintenance. It also included funds for installing continuous welded rail tracks on the remaining unfinished portion of the Hudson Line.

The 1983 Capital Plan Amendment allocated additional capital funds to Metro-North. Of the \$131.5 increase in new funds, \$46 million was for the Park Avenue Tunnel rehabilitation. Metro-North expected to replace structural steel, repair the waterproofing protection system and side walls, replace aged wiring conduits and splicing chambers, install a new drainage system and replace the roadbed under all four tracks. The rehabilitation contract was awarded in December 1986 and construction began in mid-1987. At that time, the 1982-86 commitment for the tunnel had reached \$105 million.

1987-91 Capital Program

The 1987 Capital Plan budgeted \$165.1 million for line structures work. By December 1990, Metro-North expected to commit \$183 million for this work, a \$17.9 million (10.8 percent) increase (see Table 76).

TABLE 76: 1987-91 Metro-North Line Structures Elements
(\$ in millions)

| Element | Commitments | | Change | |
|--------------------------------|----------------|---------------------|---------------|--------------|
| | Original Plans | Current Projections | Amount | Percent |
| Interlocking Improvements | \$ 20.4 | \$ 23.8 | \$ 3.4 | 16.7 |
| Bridge & Tunnel Rehabilitation | 46.0 | 74.5 | 28.6 | 62.1 |
| Track Improvements | 83.7 | 77.8 | -5.9 | -7.0 |
| Capacity Improvements | <u>15.2</u> | <u>7.0</u> | <u>-8.2</u> | <u>-53.8</u> |
| Total | <u>\$165.1</u> | <u>\$183.0</u> | <u>\$17.9</u> | <u>10.8</u> |

Source: March 1987 Capital Plan and December 1990 Proposed Capital Plan Amendment

The 1987-91 Capital Program provided for important improvements and repairs to Metro-North line structures:

- o Structural inspections of the Park Avenue and Yonkers viaducts to determine the repairs required to ensure continued safety and to prevent further deterioration.

- o A survey and inspection of all Metro-North bridges in New York State including an evaluation of each bridge's condition and priority with respect to need; the development of a program to rehabilitate the bridges, and the design and engineering of rehabilitation projects for high-priority structures.
- o An annual track rehabilitation program, including installing concrete ties, to ensure that all track, ties and ballast are renewed within their life-cycles.
- o Right-of-way drainage improvements to alleviate critical drainage problems in Metro-North's tracks and yards.
- o Reconfiguring the Mott Haven Interlocking and improving other interlockings to increase operational flexibility.
- o Rehabilitating the Middle and Fort Montgomery Tunnels on the Hudson Line, which were in critical need of repair.
- o Repairing the Yonkers Viaduct and rehabilitating selected bridges.
- o Engineering and design work for rehabilitating the Park Avenue Viaduct.

The interlocking improvements were generally on schedule and within budget. However, the Miscellaneous Interlocking project was delayed nine months following a change of scope. The original plan called for the switches to be rewired, but it was decided to install "state of the art" equipment. This required the installation of new switches manufactured in Europe. Before purchasing this equipment, the railroad needed to resolve legal problems tied to "Buy America" provisions in its standard contracts.

Commitments for the Mott Haven Interlocking project increased from \$8.2 million to \$13.2 million because after preliminary design, soil borings and soil testing, engineers decided that more money was needed to complete the project. Waiting to receive additional funding from UMTA caused a one-year delay in the projected completion date, although work might be finished early.

Most bridge and tunnel projects were completed on schedule and within budget. However, the rehabilitation of the New Hamburg Bridge over Wappingers Creek has been delayed. It is presently set in a permanently closed position, and has been since 1978. The U.S. Coast Guard considers the creek a navigable waterway and wants the bridge converted into a functioning drawbridge. The rehabilitation design has been completed, but construction is on hold. If Metro-North is forced to adopt the Coast Guard plan, the project will have to be redesigned. In addition, Metro-North has increased the budget as a result of actions taken by the U.S. Coast Guard. A bill declaring the bridge a fixed structure is now before Congress and Metro-North is waiting to find out whether it will be passed.

The four-track Park Avenue Tunnel from 57th Street to 97th Street is the subject of a major rehabilitation effort begun under the first Capital Program. The construction contract was awarded in December 1986 and work began in August 1987. The work includes repairing waterproofing systems, fixing the tunnel roof and side walls, replacing aged wiring conduits and splicing chambers, installing a new drainage system, and replacing roadbed under all four tracks. Tracks 3 and 4 have been rehabilitated and work has begun on Tracks 1 and 2.

This project was supposed to be completed in August 1991, but there has been a ten-month delay. Metro-North now expects the project to be finished in June 1992. There are two major reasons for this delay.

First, the design for the tunnel roof had to be changed from a pre-cast to a cast-in-place concrete system when wood pilings were discovered which had not appeared on the drawings or during earlier test borings. Following this plan, however, would have added \$20-30 million to the cost of the work and would have taken two years longer to complete. Instead, Metro-North decided to redesign the tunnel roof.

Second, the concrete ties cast for the tunnel were defective and Metro-North decided to replace them with wood ties. The railroad is attempting to recover the monies spent on the concrete ties through litigation and is also trying to find a buyer for them.

The current budget for the project is \$144 million, an increase of \$7.9 million over the original budget. In addition to more design work for the tunnel roof, costs for work trains and expansion joints were originally underestimated. There has been minimal impact on the operation of the railroad at GCT.

The track rehabilitation projects for 1987-91 have been completed on time and within budget. The Rail Bed Improvements and the New Rochelle Drainage projects were brought in under budget. The New Rochelle project was also completed ahead of schedule. The retaining wall projects are on time and within budget.

Two bridge rehabilitation projects needed budget increases after detailed structural assessments revealed greater than anticipated deterioration. Instead of making relatively simple repairs or replacing components, the railroad must replace entire bridge superstructures. This extra work raised the estimated cost of these projects from \$800,000 to \$2.8 million (see page 139).

Several studies in the Capacity Improvements element did not proceed as planned due largely to changes by Metro-North's planning partners. As a result, the budget allocation decreased almost 54 percent. New Jersey Transit has delayed awarding one contract to study improvements for West of Hudson service and it is reviewing its plans to share the costs of a West Shore Line study. As of September 1991, Metro-North had decided to defer the latter study because of higher priorities. (For more on how outside agencies led to project delays see page 147.)

Proposed 1992-96 Capital Program

Metro-North's proposed third Capital Program calls for spending \$380.8 million to continue rehabilitating its line structures and maintaining its track and switches. The proposed 1992-1996 program focuses on major track and turnout rehabilitation/replacement. Metro-North also plans to upgrade and paint its bridges and rehabilitate the Park Avenue Viaduct. A third track between Mt. Vernon West and Crestwood is also planned to increase service capacity on the Harlem Line.

The proposed plan also calls for track work on the Dover Plains Branch, replacing switch equipment, providing improved drainage at selected locations, and installing passing sidings to upgrade West of Hudson service.

Of the \$381 million proposed for the line structure category, \$216 million is earmarked for the rehabilitation of Metro-North's many overgrade and undergrade bridges, viaducts, tunnels and retaining walls. The key project will be rehabilitating the two-mile long Park Avenue Viaduct including repairing girders, columns and retaining walls, and replacing the existing deck with a new one of concrete.

Planned line structures improvements include rehabilitating the Grand Central Terminal Train Shed and Terminal Approach area, including repairing structural elements and the tunnel where required.

Eighteen undergrade bridges located on all three main lines are also to be repaired during 1992-96. These repairs were given priority based on a study which determined which structures were most in need of repair. Other work will include rehabilitating and painting selected overgrade bridges, repairing retaining walls and drainage systems, installing new fencing, rehabilitating Hudson Line tunnels to eliminate water seepage problems, and replacing components on several open deck bridges.

Progress Toward a State of Good Repair

Major work remains to be done before Metro-North's line structures attain a systemwide state of good repair. The railroad anticipates that deficient areas will be replaced or repaired over the next several proposed capital programs and that a good state of repair will be reached in 2011.

Metro-North's bridge rehabilitation program and its right-of-way improvements will correct some of the deficiencies. During 1992-96 the railroad plans to rehabilitate the Park Avenue Viaduct and will start extensive repairs to the Park Avenue Tunnel Train Shed. Rehabilitating overgrade bridges will take until 2011 because of the large number of such bridges and the need to coordinate repair work with normal railroad operations.

SIGNALS AND COMMUNICATIONS

Metro-North's signal system was installed in stages from the late 1920s to the late 1950s. In New York State where Metro-North has 560 miles of tracks, approximately 525 track miles had automatic block signals, while the remaining 35 track miles had manual block signalling. On the New Haven Line, the signal system had been upgraded prior to 1981 as part of an UMTA/MTA Modernization Program.

The signal system contributes to the safe operation of trains by regulating the distance between trains and providing information about any obstructions on the track which have triggered the signals. According the MTA's 1980 "Staff Report on Capital Revitalization,"

The optimal form of signaling for a heavily trafficked commuter rail operation consists of centralized traffic control with cab signaling and overspeed protection. This form of signaling provides for control of trains on any track in either direction, with signal information presented in the cab of the train. Overspeed control automatically stops a train if the maximum speed permitted by a signal is exceeded.

In addition to signals, this category also includes communications equipment and interlockings. Communications between various railroad facilities and trains are transmitted by radio, telephone and microwave equipment. Interlockings are locations where tracks connect or diverge and the switches are "interlocked" so that a conflicting route cannot be set up. All-electric interlockings permit an operator to control several interlockings from a central location. These replace the obsolete electro-mechanical interlocking devices which require an operator to manually move levers causing electric circuits to move the necessary switches.

1982-86 Capital Program

The 1981 Capital Plan allocated \$74 million for signals and communications. At the conclusion of the first Capital Program, \$76.9 had been committed (see Table 77). The focus of the 1982-86 program was the installation of cab signaling on all tracks from Mott Haven to Croton-Harmon (Hudson Line) and from Mott Haven to Brewster (Harlem Line).

TABLE 77: 1982-91 Metro-North Signals and Communications Program
(\$ in millions)

| Period | <u>Commitments</u> | | <u>Change</u> | |
|---------|---------------------------|--------------------------------|---------------|----------------|
| | <u>Original Plans</u> | <u>Current Projections</u> | <u>Amount</u> | <u>Percent</u> |
| 1982-86 | \$ 74.0 | \$ 76.9 | \$ 2.9 | 3.9 |
| 1987-91 | 40.5 | 53.9 | 13.4 | 33.1 |

Source: September 1981 and March 1987 Capital Plans; December 1990 Proposed Capital Plan Amendment

Installation of new cab signaling on all tracks from Mott Haven to Croton Harmon on the Hudson Line, and to North White Plains on the Harlem Line was completed in 1989. In addition, in 1985 a comprehensive analysis of Grand Central Terminal operational needs was undertaken to determine track, signal and switch facilities required for future operations.

1987-91 Capital Program

Originally, \$40.5 million was budgeted for Signals and Communications for 1987-91. Increases to the program brought the total amount committed to \$53.9 million, a \$13.4 million (33 percent) increase (see Table 78). Most of the increase was due to the addition of several new signal projects.

The 1987-91 Capital Program provided additional funding in 1988 to complete the installation of cab signaling south of Mott Haven to 57th Street. This work is now underway. Rehabilitating signal and communication lines between Harmon and Poughkeepsie was nearly completed, but some work was

deferred to 1992 because of difficult terrain. The 1987-91 Capital Program also provided \$1 million for Centralized Traffic Control for the New Haven Line. This project should be finished by December 1991.

Most of the \$9.4 million increase in the budget for the GCT Signals, Interlock and Track project is for a \$7 million project to upgrade GCT switches and switch machines. The rest is for extra force account work, spare parts and engineering. This project, scheduled for completion in 1992, will bring the GCT signal and interlocking complex to a state of good repair, improve operational reliability, reduce delays, and improve efficiency by eliminating out-dated and redundant equipment.

TABLE 78: 1987-91 Metro-North Signals and Communications Projects
(\$ in millions)

| <u>Project</u> | <u>1987 Plan</u> | <u>1991 Plan Amendment</u> |
|--|----------------------|--------------------------------|
| Hudson/Harlem Cab Signaling | \$ 0 | \$ 3.4 |
| Centralized Traffic Control - New Haven | 0 | 1.0 |
| New Haven Line - Go-No-Go System | 0 | 0.6 |
| Cab Signals - Mott Haven South | 0 | 5.9 |
| GCT Signals, Interlock & Track | 31.2 | 40.6 |
| GCT Switch & Switch Machine Replacement | 7.0 | 0.0 |
| Upper Hudson Communication & Signal Improvements | <u>2.3</u> | <u>2.3</u> |
| Totals | <u>\$ 40.5</u> | <u>\$ 53.9</u> |

Source: March 1987 Capital Plan and December 1990 Proposed Capital Plan Amendment

Metro-North completed most projects in this category on schedule and within or under budget, but there were two exceptions. The Mott Haven South Cab Signals project was originally scheduled to be finished in December 1991. It has since been rescheduled for completion in December 1992. This project was delayed because it was coordinated with track work in the area and a delay in the track work also delayed the signal project. It also required a \$900,000 budget increase. According to the project manager, current projections are that if signal system installation can be completed prior to track work, the schedule can be accelerated to June 1992.

The second project, Upper Hudson Communication and Signals Improvements, called for replacing 47 miles of pole lines. Forty miles have been completed and the remaining seven miles have been deferred until the 1992-1996 program. According to the project manager, there will be some added cost to this \$2.3 million project because of a rocky terrain problem which Metro-North forces were unable to handle. Additional design work is required and construction will probably be contracted out.

Proposed 1992-96 Capital Program

Metro-North's proposed 1992-96 Capital Program calls for \$41.4 million for signal and communications improvements. One project will convert the signals north of Peekskill (Hudson Line) and north of North White Plains (Harlem Line) to Metro-North's standard system. Another project will integrate shorter blocks of the Upper Harlem Line into the existing signal system.

Radio and police communications equipment are also proposed for improvements during 1992-96. Modifications to the radio system should simplify and improve radio transmissions on the railroad. Improvements to the police communications system will bring it to a state of good repair. Metro-North proposes replacing the existing police radio console with a new micro-processor-based central console to add flexibility and enhance safety for both passengers and employees.

The railroad proposes moving the dispatcher's office to the new Grand Central Terminal rail operations center and replacing outdated computers. Other proposed projects include replacing two interlockings, installing new signals on the New York portion of the New Haven Line, and replacing signal cables under the Harlem River.

Progress Toward a State of Good Repair

Metro-North expects that most of its signal and communication facilities will have reached a state of good repair during the 1987-91 Capital Program. A few projects must be addressed between 1992 and 1996 before the entire signal and communication system will have achieved a state of good repair. These projects include improving police and railroad radio communications, improving signals on the Upper Hudson, Upper Harlem and New Haven lines, improving several interlockings and removing obsolete materials and pole lines. Completing these projects and achieving a state of good repair for signals and communications is anticipated by the end of the proposed third Capital Program in 1996.

POWER

Power equipment converts electricity from utilities to a usable form for trains and conveys it to third rails or overhead (catenary) wires. Included in this category are substations which convert alternating current to direct current, third rail which provides electricity to trains through the "car shoe," and the New Haven Line's catenary system, which transfers power through a system of overhead wires and devices on top of cars (pantographs). The 1982-86 Capital Program focused on the Harlem and Hudson lines where 19 existing substations built from 1905-1925 used obsolete equipment, and were in urgent need of replacement.

1982-86 Capital Program

Metro-North budgeted \$193.5 million for its power needs at the start of the 1982-86 Capital Program. By the end of the first program, the railroad planned to commit \$195.3 million to accomplish its goals.

Metro-North planned to construct 38 new substations. In addition, 70 lb/yd. third rail was to be replaced by 150 lb/yd. rail. The lighter rail has not

been produced since the 1950s and its low conductivity hampers the proper operation of train equipment and air conditioning.

TABLE 79: 1982-91 Metro-North Power Program
(\$ in millions)

| <u>Period</u> | <u>Commitments</u> | | <u>Change</u> | |
|---------------|---------------------------|--------------------------------|---------------|----------------|
| | <u>Original Plans</u> | <u>Current Projections</u> | <u>Amount</u> | <u>Percent</u> |
| 1982-86 | \$ 193.5 | \$ 195.3 | \$ 1.8 | 1.0 |
| 1987-91 | 81.8 | 84.6 | 2.8 | 3.4 |

Source: September 1981 and March 1987 Capital Plans; December 1990 Proposed Capital Plan Amendment

Due to problems encountered during real estate condemnation proceedings and the siting of substations, not all of the substation contracts were awarded during the first five-year Capital Program. Three substation projects were deferred to the 1987-91 Capital Program.

1987-91 Capital Program

In 1987, Metro-North budgeted \$81.8 million for power projects in its 1987-91 Capital Program. According to the 1991 Proposed Capital Plan Amendment, \$84.6 million was to be committed to achieve Metro-North's goals for this category, as shown in Table 79.

While the 1982-86 Capital Program focused primarily on improving the Harlem and Hudson power delivery systems, the second one focused on improving the New Haven Line and Grand Central Terminal. For the 1987-91 Capital Program, eight projects were included, as shown in Table 80. Several significant revisions were made in the original 1987 plan which affected project schedules and budgets.

TABLE 80: 1987-91 Metro-North Power Projects
(\$ in millions)

| Project | 1987 Approved Plan | 1991 Plan Amendment | Change | |
|--|-----------------------|------------------------|---------------|------------|
| | | | Amount | Percent |
| Hudson/Harlem Substation & 3rd Rail Modernization | \$ 2.8 | \$ 17.4 | \$ 14.6 | 521.4 |
| Anchor Bridge Substation Replacement | 15.8 | 0.0 | -15.8 | -100.0 |
| New Haven Line Catenary Improvement | 35.1 | 47.3 | 12.2 | 34.8 |
| GCT 3rd Rail & Feeder Replacement | 28.1 | 2.8 | -25.3 | -90.0 |
| Improve New Haven Line Power Control | 0.0 | 1.0 | 1.0 | -- |
| GCT Feeder Replacement Phase II | 0.0 | 11.1 | 11.1 | -- |
| GCT 3rd Rail Replacement | 0.0 | 0.9 | 0.9 | -- |
| GCT Feeder Phase II B | <u>0.0</u> | <u>4.2</u> | <u>4.2</u> | <u>--</u> |
| Total | <u>\$ 81.8</u> | <u>\$ 84.6</u> | <u>\$ 2.8</u> | <u>3.4</u> |

Source: March 1987 Capital Plan and December 1990 Proposed Capital Plan Amendment

In December 1987, a design contract was awarded for the rehabilitation of the New Haven Line catenary system. In 1990, construction started on the New York portion of the catenary system. This project was allocated \$35.1 million, but in March 1990 the budget increased by \$12.2 million (35 percent) to \$47.3 million.

The New Haven catenary project's budget rose after the final design was completed. According to the Metro-North project manager, the increase was due to completing final construction implementation and staging plans, labor and material escalation, and additional structural rehabilitation requirements. The cost increase was funded by deferring some work originally planned for the Grand Central Terminal Third Rail and Feeder Replacement project to the proposed 1992-96 Capital Program.

The New Haven Line catenary project was delayed by one year. This was caused by a delay in receiving UMTA funding for this project (see page 240). UMTA funding was received in the last quarter of 1990 and Metro-North awarded a contract in April 1991. This project is now scheduled to be completed during the last quarter of 1993.

The power equipment work originally planned for Grand Central Terminal was reconfigured into several new projects. The first phase of the replacement of GCT power feeders started in 1988. Construction will continue into the proposed third five-year program. Design of the replacement of third rail in GCT started in 1990. Construction of this project is proposed after 1991.

As a result of the delay in the New Haven catenary project, Metro-North deferred the Anchor Bridge substation replacement project until the 1992-96 Capital Program. It was deferred for two reasons: the New Haven project cost increase necessitated making up the shortfall; and until the catenary program is completed, replacing the Anchor Bridge substation would serve no purpose because the substation will not be operational until the new catenary system is working.

The Hudson/Harlem Substation and Third Rail Replacement project was carried over from the 1982-86 Capital Program. As previously discussed, problems were encountered with locating sites for three substations. As a result, while this project's budget stayed within its 10-year \$208 million limit, the 1982-86 budget was reduced by approximately \$15 million and a corresponding increase was transferred to the 1987-91 Capital Program.

Proposed 1992-96 Capital Program

Metro-North proposes to spend \$41.4 million to continue bringing its power distribution system to a state of good repair. The projects are largely ones deferred from the 1987-91 Capital Program. The Anchor Bridge substation project involves replacing four aged substations and includes related feeder connections to the existing catenary.

The Grand Central Third Rail Replacement project will go beyond the proposed third Capital Program. Fifteen miles of third rail is to be replaced in 1992-1996. This work is expected to minimize train delays and further reduce third rail fires and system maintenance. The final proposed project in the power category involves replacing or rehabilitating stray current mitigation devices on the Harlem and Hudson lines.

Progress Toward a State of Good Repair

The installation of new power equipment on the Hudson and Harlem lines has improved performance and restored these lines to a state of good repair. However, the railroad estimates that it will reach a state of good repair for its entire system by 2001.

Two major projects need to be completed before Metro-North's power equipment reaches a state of good repair. The four Anchor Bridge substations, deferred from the 1987-91 program, are now scheduled to be completed during the proposed third Capital Program. Installing 30 miles of third rail within the Grand Central Terminal complex must be scheduled from 1992 to 2001.

SHOPS AND YARDS

Many shops used to maintain electric and diesel cars were constructed in the early 1890s and were inadequate to service the required number of cars. With the addition of new cars to the fleet, the railroad anticipated an added

strain on the existing maintenance facilities. New or expanded shop facilities were needed to help reduce the number of cars held in reserve in the shops from an unacceptable level of 33 percent to 12 percent, to substantially contribute to reducing the average car shortage of 50 cars per day and the 5,657 train delays annually due to car equipment failures.

The program for shops and yards called for modern shops and shop equipment to provide essential maintenance efficiently. The program was to provide for modernization of the Harmon Shop, as well as new or expanded shops at North White Plains, Brewster, Poughkeepsie and Grand Central Terminal. Maintenance-of-Way facilities were also targeted for major upgrades.

1982-1986 Capital Program

The first Capital Program budgeted \$35.2 million for shops and yards (see Table 81). By the end of the 1982-1986 program, Metro-North had committed \$86.3 million, an increase of \$51.1 million (145 percent). This increase was largely due to the infusion of almost \$30 million in 1983 for new or expanded projects and the inclusion of \$10 million of "pre-1982" funds into the budget.

TABLE 81: 1982-91 Metro-North Shops and Yards Program
(\$ in millions)

| Period | Commitments | | Change | |
|---------|-------------------|------------------------|---------|---------|
| | Original Plans | Current Projections | Amount | Percent |
| 1982-86 | \$ 35.2 | \$ 86.3 | \$ 51.1 | 145.2 |
| 1987-91 | 79.9 | 74.1 | -5.8 | -7.3 |

Source: September 1981 and March 1987 Capital Plans; December 1990 Proposed Capital Plan Amendment

The September 1981 Capital Plan emphasized modernizing and upgrading shop facilities at Harmon, building a new electric car shop at Brewster, and improving facilities at North White Plains, Grand Central Terminal and Poughkeepsie.

Work on the Harmon Shop included upgrading and modernizing the main shop, constructing a new car washing facility, and providing mechanical, electrical and service area improvements. Specific improvements included the inspection and running repair area, the main service and repair area, office and comfort facilities, and support shop facilities including air brake, electric, machine, wheel truck and upholstery. The upgraded shop was completed in 1985.

Besides the major renovation required at Harmon, a new electric car shop was needed at Brewster to maintain cars stored at that terminal and to avoid having to transfer cars to and from Harmon to receive their required maintenance. The new Brewster Shop was completed in 1987.

The facilities at North White Plains and Grand Central Terminal needed upgrading to provide the maximum number of cars for service each day. A new repair shop was constructed at North White Plains and improvements to the GCT locomotive servicing facility were also completed.

Prior to the 1982-86 Capital Program, many of the railroad's Maintenance-of-Way facilities consisted of trailers, old box cars, and temporary buildings, all of which were substandard. These structures did not provide adequate offices, workshops and storage areas to enable employees to work safely and efficiently. New Maintenance-of-Way facilities were to include new structures at Mott Haven and North White Plains. Work on such facilities was deferred to the second Capital Program.

The shops and yards budget increased in 1983 when \$12 million was transferred from a miscellaneous capital budget category and \$17.5 million in new funds was added to the program. The transferred funds provided for improving the Harmon Shop (\$6 million), the Harmon Sewage Treatment Plant (\$2 million), Brewster drainage improvements (\$3 million), and Poughkeepsie track improvement (\$1 million). The funds also provided \$8 million for new car washers, \$8.5 million for upgrading the North White Plains Yard and \$1 million for West of Hudson yard facilities.

The new projects called for in 1983 were largely completed. Car washers were constructed at Brewster and Harmon, a new sewage treatment facility was constructed at Harmon, and car servicing facilities were completed at Brewster, North White Plains and Harmon Yards. Improvements to the Port Jervis Yard Line were also completed.

1987-91 Capital Program

Metro-North budgeted \$79.9 million for its shops and yards projects at the start of the second Capital Program in March 1987. By December 1990, Metro-North expected to commit only \$74.1 million, \$5.8 million (7.3 percent) less than originally planned.

In contrast to the first Capital Program, the 1987-91 program consisted mainly of smaller projects to improve existing shops, yards, and employee and storage facilities. With few exceptions, these projects were completed on schedule and within budget.

Another group of smaller projects in the 1987-91 Capital Program were for improving Metro-North's compliance with environmental regulations at its shops and yards. Due to years of inattention to this important area, the railroad needed improved water distribution, waste disposal and storage facilities to eliminate the dumping of hazardous materials into adjacent property. Some of these projects were delayed because Metro-North had to satisfy DEC requirements and deadlines. (See page 148 for a discussion of the role of DEC on Metro-North capital projects.)

The 1987-91 Capital Program called for improving and expanding the Harmon material storage and distribution facilities. Construction of new indoor material storage facilities and expanded exterior storage areas were completed in September 1990, three months ahead of schedule.

Prior to 1987, Metro-North lacked a properly equipped centralized Maintenance-of-Way equipment repair facility. The 1987-91 Capital Program provided funds for constructing such a facility at North White Plains.

According to Metro-North's Senior Engineer for Shops and Yards, this project was basically completed in April 1991, three months ahead of schedule and within budget.

Design, engineering and construction of a welfare, training and repair facility for the Communication and Signal Department was planned for North White Plains. Also planned for North White Plains was the design and construction of a headquarters for Metro-North's Maintenance-of-Way (MOW) personnel.

Design of the Communication and Signal facility was completed in December 1990, two months ahead of schedule. At that time, construction of this facility was proposed for "after 1991." The new headquarters for MOW personnel was deferred until the proposed 1992-96 Capital Program; it is to be included in the new Communications and Signal facility.

The 1987 plan described Metro-North's employee facilities as being in various states of disrepair. Improvements were planned for train-and-engine employee facilities at Harmon, North White Plains and Poughkeepsie. Maintenance-of-Equipment employee facilities, and employee facilities and support shops at Grand Central Terminal were also planned to be upgraded. In addition, a substation at Mott Haven was to be rehabilitated for use as a MOW employee facility and another employee facility was to be constructed at Port Jervis.

Designs for employee facilities at Harmon, North White Plains and Poughkeepsie were completed in June 1989. The Harmon facility was completed in February 1991, two months after the scheduled completion date. Changes in the project's design were caused by a decision to move the location of the facility from its original site. Work was completed on the new North White Plains facility in January 1991.

While design of the Poughkeepsie employee facility was completed in 1989, construction of this project was deferred. According to Metro-North's Assistant Director of Facilities Engineering, a new Poughkeepsie yard is being planned for the proposed 1992-96 program and railroad officials decided there are ample existing facilities for current employees.

Improvements to employee facilities and support shops at Grand Central Terminal were halted in late 1989 due to Metro-North's efforts to allocate space within GCT according to its space utilization study. Some design work was undertaken for the employee facility; Metro-North employees are building a temporary common lunchroom and locker room.

Construction of an employee facility at Port Jervis was completed in 1988. Design of the Mott Haven MOW facility was completed in August 1989 and construction began in December 1989.

The 1987-91 Capital Program also provided funds to rehabilitate the Harmon Shop roof and for water distribution improvements at both Harmon and Brewster yards. The Harmon roof project was delayed because of requirements imposed by DEC. Water distribution improvements at North White Plains were completed one year ahead of schedule in December 1990. The Harmon water distribution project was completed in February 1991.

Proposed 1992-96 Capital Program

Metro-North proposes spending \$57.9 million for shops and yards during 1992-96. Four major projects account for \$48.6 million (84 percent) and the remainder of the budget is for miscellaneous shop and yard improvements. Several of the major projects of the proposed 1992-96 Capital Program are carried over from the 1987-91 Capital Program. Some started the early stages of design in the 1987-91 Capital Program.

One major project is the clean-up of contamination in the Harmon Lagoon and its surroundings. Metro-North is placing more emphasis on achieving a better environment for its employees, community residents and customers. There will also be a new fueling facility at Harmon built in compliance with DEC requirements and providing improved fuel distribution. In building this new fueling facility the contaminated soil at the existing fuel pad will be cleaned. These two projects at Harmon account for almost half of the 1992-96 shops and yards budget.

Other major projects are the Communications and Signal (C&S) training facility at North White Plains and the Poughkeepsie Yard/Train and Engine (T&E) Facility. The C&S facility will be a new building which provides training and employee facilities for North White Plains workers. The Poughkeepsie Yard will provide greater storage capacity, upgraded equipment and increased flexibility of train movements for the Upper Hudson Line. These two projects comprise 40 percent of the proposed 1992-96 shops and yards budget.

Progress Toward a State of Good Repair

Metro-North expects most of its shops and yards to achieve a state of good repair by 1996. However, the Harmon Lagoon Remediation project must be completed to meet New York State and Federal environmental requirements. Final achievement of a state of good repair status for Metro-North shops and yards is projected for 2006.

SECTION THREE: OTHER ISSUES

Our review of the MTA Capital Program focused on whether the Transit Authority, Metro-North, and the Long Island Rail Road had achieved their goals of building specific projects on schedule and within budget. Section Two presents our assessment of how well each of these agencies did.

Besides our findings on specific capital projects and Capital Program categories, we found several issues which cut across categories and, in some cases, agencies. These issues include deficiencies in planning and design phases, sharp increases in TA labor costs, massive revisions to LIRR Capital Program priorities, and delays due to the intervention of other government agencies.

ABSENCE OF CONDITION SURVEYS DURING PLANNING

Proper capital planning requires complete information about the condition of capital facilities and equipment. Without such information, capital funds cannot be targeted effectively because there is no way to tell whether funding allocations address an agency's most critical needs, whether funding levels are adequate, and whether some needs remain unaddressed.

Transit Authority

The TA's 1982-86 and 1987-91 Capital Programs were both prepared without the benefit of complete and accurate information about the condition of the TA's property, facilities, and equipment. As a result, the TA had to redirect funds and change priorities during its 1982-86 and 1987-91 Capital Programs. Thus, such program areas as track, stations, and line equipment have had funding levels raised to meet unexpected needs at the expense of shops, yards, signals, and depots projects. To prevent this from happening, the TA should incorporate into its capital planning process procedures to determine the condition of its equipment, infrastructure, and facilities. Once such procedures are in place, it should make sure all information is complete and accurate and is updated periodically.

Track. The importance of surveying a capital asset's condition before devising a capital improvement strategy should have become clear to TA management during the early stages of its 1982-86 Capital Program. Management acknowledged that the TA's tracks were in poor shape and set five-year expenditures at \$365 million, enough to replace approximately 50 of its more than 700 miles of track.

During 1983, though, it became apparent that the TA had seriously underestimated how much work was needed not just to return tracks to a state of good repair, that is, to replace all worn and overage components, but to make them safe. In June 1983, after 12 mainline derailments, the Transit Authority conducted an emergency inspection that determined that the tracks in many areas were in such poor shape that it was dangerous to ride over them at normal speeds. Consequently, 512 "red tags," or emergency slow speed orders, were posted requiring train operators to slow to 5-10 miles per hour.

In 1984, a more comprehensive condition survey was performed. That one, unlike the 1983 survey which focused on safety, examined track renewal needs. This survey showed that the track network was in far worse shape than TA management had imagined when it planned the 1982-86 Capital Program. As a

result, the TA shifted more than \$225 million from other programs to substantially accelerate the track replacement and rehabilitation schedule.

Nevins Street Station. After being caught off guard by the poor condition of its tracks during the 1982-86 Capital Program, TA management should have been more alert to the importance of surveying its facilities and equipment while planning the second Capital Program. However, the TA continued to plan without adequate information about the condition of its equipment and facilities, and it has suffered the consequences of doing so.

The TA planned to spend \$458.2 million on stations from 1987-91, but it did not undertake a comprehensive structural survey of stations before deciding how to spend the money. Thus, while the main thrust of the Capital Program for stations was to "[f]acilitate passenger movement; improve passenger information; provide a greater level of passenger comfort, security and amenities; [and to] improve passenger experience of the system and increase ridership," the TA failed to determine whether any of its stations had structural defects which should be corrected before doing what turned out to be primarily cosmetic work. The TA also failed to find out whether the station power supply was sufficient to support such planned systemwide and expensive improvements as Automated Fare Collection and lighting and public address upgrades.

The effects of these omissions were first felt when serious structural defects were discovered at the Nevins Street Station in Brooklyn in 1988.* Water infiltration caused by deterioration of the sidewalk above had seriously damaged several key structural elements in the station's mezzanine. Additional steel hangers were added to support the mezzanine, and in 1989 much of the sidewalk above the station was replaced. The TA believed these measures were sufficient to prevent further deterioration and to assure the continued safe operation of the station.

Between the latter part of 1988 and October 1989, the TA's Stations, Engineering and Construction, and Track and Structures departments conducted a "comprehensive station condition survey" to prioritize future station improvements. This survey, we were told, was the TA's first comprehensive review of the structural condition of all of its 469 stations. The Station Condition Survey found 133 stations, including Nevins Street, with "apparent major structural deficiencies."

Nevins Street was surveyed on April 13, 1989. The report stated that

The present condition of this station is beyond repair. Extreme conditions of steel corrosion and concrete crumbling and falling are evidence of the degree of decay. The safety of our employees and customers is compromised seriously if a major rebuilding of the station is not undertaken immediately. It is recommended that a test of the structural integrity of this station be performed promptly. The station is directly under the heavy traffic of Flatbush Avenue

* This 83-year old station on the IRT's Eastern Parkway Line is a major transfer point between east-side and west-side IRT service in Manhattan. It consists of two island platforms serving four tracks. Above the platforms are two mezzanines and the fare control areas.

The Nevins Street Station had been included in the restoration program for 1992. Until then, the TA did not plan to make additional major repairs. Nor did it perform the tests of structural integrity that the April 13, 1989 survey recommended.

In the summer of 1990, though, additional structural problems were discovered by an Engineering and Construction Department engineer who just happened to be at the station. It was only then that TA management realized the magnitude and seriousness of the structural deterioration at Nevins Street. The Track and Structures Department used 12 x 12 timbers to shore up the mezzanine and, in September 1990, began to monitor the sagging in the mezzanine floor. That same month, the MTA Board approved a \$10 million emergency contract to reconstruct the Nevins Street Station mezzanine. Construction work began in June 1991 and is supposed to be finished by December 1992.

Nevins Street exemplifies two significant problems. First, it initially was omitted from the Capital Program due to an apparent emphasis on cosmetic station repairs while little was done to identify potential structural deficiencies. This problem can be solved by incorporating steps into the capital planning process to assess the condition of the TA's infrastructure and facilities.

However, this process will be of limited benefit if serious structural deficiencies are ignored once they are identified. This is at least as serious as failing to determine a structure's integrity in the first place. Thus, formal procedures should be developed to notify the proper parties once potentially serious structural defects are observed.

AFC Power Upgrade. Sound management requires an accurate assessment of a project's cost before committing large sums of money to developmental expenses. This is the only way to gauge whether such expenses are justified. If a project's total cost is too high, then it makes little sense to spend money on the early stages of a project that will never be completed. This, in turn, necessitates complete information about the system's condition before approving the project. If management does not know how much work must be undertaken, it cannot know the total cost of that work.

Nevertheless, the TA included a number of projects in its 1987-91 Capital Program which tapped into the station power supply without first determining whether it could power these additional improvements. As a result, the TA initiated the AFC program in 1984 and spent \$18 million to test AFC-style turnstiles in 1986, in the belief that the total program would cost \$80 million. When it was later discovered that the existing power supply was inadequate, the need to upgrade station power added \$250 million to the cost of the program.

The TA finally began to review the condition of its station power supply in 1989, six years after the introduction of the AFC program, and three years after the 1986 AFC pilot test. While the TA contends that the station power upgrade would have been needed anyway, TA managers acknowledge that the work could have been spread out over many years had it not been for the additional power required by AFC.

The assumption that station power was adequate for AFC was based, in part, on the conclusions of a 1984 Arthur D. Little study. Little reported that "we tested the station power in six of our representative stations. In all cases,

we found the existing power supplies more than adequate to serve the demand of the swipe-reader equipped turnstiles. If more power is needed, additional or larger gauge wire can be pulled through the existing conduits." The study, however, only considered the power needed for the turnstiles. It failed to take into account the additional power needed for the AFC station controller, improved station lighting, communications, and public address systems.

While the Little study erred in assuming that station power was adequate, the TA, because it had not assessed the power, did not know that the power supply would be inadequate after lighting and public address improvements were made. We also question the wisdom of assuming that station power was adequate for the AFC turnstiles based on a survey of just six of the TA's 469 stations.

Emergency Ventilation Fans. The Capital Program for emergency ventilation fans was ten years old before the TA commissioned a systemwide survey of the existing ventilation system. From 1982 through 1991, the TA pursued a policy of replacing fans "as required," and doing its best to keep almost 200 antiquated fans operating. It was not until the December 28, 1990 Clark Street tunnel fire highlighted the importance of the emergency ventilation system that the TA awarded a contract to survey the ventilation system, determine what the TA's ventilation needs are in light of current National Fire Prevention Association safety standards, assess the adequacy of the ventilation system, and develop an overall ventilation strategy.

Long Island Rail Road

Poor planning of separate consultant contracts for inspection and design of the Atlantic Avenue Viaduct caused the completion of this major LIRR state-of-good-repair project to be delayed one and a half years, and approximately \$175,000 to be spent unnecessarily. An additional \$13 million had to be diverted from other planned LIRR projects to fund a budget increase needed to pay for repairs to this structure.

Based on a 1987 in-house assessment, the railroad estimated that it would require \$14 million to bring the Atlantic Avenue Viaduct in Brooklyn to a state of good repair. The viaduct is an 85-year old elevated steel structure which is one and one-half miles long. While LIRR employees have periodically repaired it, the structure suffers from corrosion, missing parts, and bent steel members. Permanent repairs are necessary to prevent further deterioration and to maintain its structural integrity.

In September 1987, the LIRR hired the engineering firm of Kirti A. Gandhi. The Request for Proposals (RFP) required Gandhi to inspect the entire viaduct and prepare an evaluation report but not design the rehabilitation. Based on the repair cost estimate contained in Gandhi's June 1988 report, the MTA reduced the project budget from \$14 million to \$10.6 million.

According to the current LIRR project manager, though, the June 1988 report was flawed and it could not be used as the basis for the project. Gandhi had underestimated repair costs because he did not take operating conditions into account. Thus, the report did not consider the limited productive repair time possible on a two-track structure and, consequently, overlooked overtime and premium pay for night and weekend work.

Another RFP was issued and Lichtenstein Engineering Associates (LEA) was awarded a contract in May 1989 to inspect and design the viaduct rehabilitation. Included in the RFP was a listing of viaduct components that Gandhi identified as needing rehabilitation. The LIRR indicated, however, that the list was for information only and not to be used for final design. The project manager stated that LIRR's original decision to split the inspection and design contracts had been a mistake. Design consultants will not generally use another firm's inspection report as the basis for their own design.

LEA issued its final inspection and design report in January 1990, estimating the viaduct's repair cost at \$34 million. According to the LIRR project manager, LEA identified the same problems as Gandhi, but its report was more detailed and indicated causes and solutions to the structural problems. Additionally, we were told that the two reports differed because Gandhi identified problems needing immediate repair while LEA looked at the repair work in a longer time frame for sustaining a state of good repair. LEA also accounted for LIRR operating conditions in its report.

Based on LEA's inspection and design work, the LIRR proposed a project for the 1992-96 Capital Program to repair the viaduct including painting, to return it to its original 50-year life, thereby achieving a state of good repair.

Following the LEA report, the LIRR hired another consultant to verify LEA's report. The third consultant, Maciez P. Bieniek, issued his report in June 1990 confirming LEA's structural ratings and repair recommendations.

The proposed 1992-96 Capital Program includes \$30 million for work which will restore the viaduct to a state of good repair. According to LIRR officials, previous estimates, as high as \$150 million, were for work which would have brought the viaduct to a condition in excess of operational and structural needs.

The process used by the LIRR to determine the needed repairs to the viaduct was clearly inadequate. Construction to achieve a state of good repair will not be achieved until one and a half years beyond the planned completion date. In addition, the LIRR spent approximately \$160,000 on Gandhi's preliminary inspection report which the LIRR's design consultant could not use. As a result, time and money were lost and ultimately a third opinion needed to be sought, further delaying the project.

These conclusions are verified by the MTA's Director of Construction Oversight. He stated that he is not at all surprised that LEA acted as it did. According to him, it is widely known that "no engineering firm in its right mind would base its design on someone else's inspection." He also remarked that the LIRR's scope of work for Gandhi's inspection was very general and that the inspection performed was of a preliminary nature. He stated that the best way to handle such a project is to perform a complete inspection from the outset.

Another consequence of the inadequate scoping process is that money had to be diverted from other projects to fund the increased cost of viaduct repairs. Although the budget first dropped by \$4 million between 1988 and 1989, during the 1990 to 1991 period \$25 million was added to the project. This was part of \$211 million in increases to LIRR projects needed at this time. To provide these increases, corresponding decreases occurred throughout the LIRR's Capital Program, including deferring several state of good repair projects.

To avoid this type of problem in the future, the LIRR should seek advice from MTA and industry experts when planning major rehabilitation projects, such as viaduct repair, for the first time.

DESIGN PHASE SHORTCOMINGS

Transit Authority

In 1984, a consultant study ("the Littlefield Report") pointed out that during the early years of the TA's Capital Program the TA had failed to ensure that projects were well-designed. The TA responded by promulgating a comprehensive body of project design procedures. Subsequently, in an August 1988 report,* we noted that "additional work orders have dropped both in number and total dollar value since 1985." In 1985 the TA Engineering and Construction Department approved nearly \$30 million in additional work orders. In 1986 and 1987 that figure dropped to \$10 million and \$11 million, respectively.

While 1988 figures are not available, we found that in 1989 and 1990 the cost of additional work orders for Engineering and Construction Department projects rose again to \$24.5 million and \$18.4 million, respectively. During the first five months of 1991, \$5.2 million in additional work was approved. Thus, we fail to see a significant long-term downward trend in the cost of additional work orders.

Additional work orders are categorized by the factors that generated them:

- unexpected field conditions;
- changes in construction criteria; and
- design errors and omissions.

Additional work is blamed on unforeseen field conditions when a condition is discovered at the site that could not be anticipated by the project's designer. Such conditions include structural deterioration behind walls or under floors and ceilings and errors caused by mistakes in TA blueprints. Changes in construction criteria occur when the TA changes its standards for design or construction. Design errors or omissions result from errors in contract plans or specifications which have not been properly reviewed or corrected before the contract is awarded.

Of the \$48 million in additional work orders approved between January 1, 1989 and June 6, 1991, more than three-quarters of this cost was attributable to unforeseen field conditions. Approximately 9 percent was due to design errors and omissions (see Table 82).**

* New York City Transit Authority's Procedures and Practices for Processing Additional Work Orders in its Capital Construction Program: A Review; MTA/IG 88-2; August 30, 1988.

** These percentages are based on information provided by the TA and are unaudited.

**TABLE 82: Engineering and Construction Department Additional Work Orders,
January 1989 - May 1991
(\$ in millions)**

| <u>Year</u> | <u>Field Conditions</u> | | <u>Change/Criteria</u> | | <u>Errors/Omissions</u> | | <u>Total</u> | |
|-------------|-------------------------|----------------|------------------------|----------------|-------------------------|----------------|---------------|----------------|
| | <u>Amount</u> | <u>Percent</u> | <u>Amount</u> | <u>Percent</u> | <u>Amount</u> | <u>Percent</u> | <u>Amount</u> | <u>Percent</u> |
| 1989 | \$ 16.6 | 67.7 | \$ 6.1 | 24.8 | \$ 1.8 | 7.5 | \$ 24.5 | 100.0 |
| 1990 | 16.7 | 90.8 | 0.2 | 1.0 | 1.5 | 8.2 | 18.4 | 100.0 |
| 1/91-5/91 | 3.4 | 66.7 | 0.8 | 15.9 | 0.9 | 17.4 | 5.2 | 100.0 |
| Total | \$ 36.7 | 76.4 | \$ 7.1 | 14.7 | \$ 4.2 | 8.8 | \$ 48.1 | 100.0 |

Source: TA Engineering and Construction Department

Design Errors and Omissions. From 1989 through May 1991, approximately 9 percent (\$4.2 million) of all additional work order charges incurred by the Engineering and Construction Department were due to design errors and omissions. While this is an improvement over our 1989 review of the Station Modernization Program, where 26 percent of all additional work order costs between 1982 and 1989 were due to design errors and omissions, we noted several projects during the current review which incurred significant additional costs due to design errors and omissions.

As of March 1991, the Jamaica Maintenance Shop had \$4.8 million in approved additional work order costs. More than 12 percent of this cost, \$571,000, appears to have been caused by design errors and omissions. One particularly costly additional work order (AWO) which probably could have been avoided was poorly placed utility lines in the work pits. As designed, these air, water, and electrical lines would have interfered with maintenance crews working on the trains. A \$337,500 additional work order was required to correct the problem.

The new Flushing Depot experienced costly additional work due to design errors and omissions which might have been spotted during a more thorough design review. Because it was built on soft ground, the depot had to be built on piles to prevent excessive settling. However, the design consultant failed to take adequate measures to prevent utilities, such as fuel tanks and the Brooklyn Union Gas Company connections, from settling. As a result, some utility lines ruptured. As of May 21, 1991, the contractor had submitted \$368,000 in additional work orders to correct the problem. The final cost of this mistake will be about \$1.2 million.

It is not possible to eliminate design errors and omissions completely, but mistakes can be minimized by proper design review. The TA Engineering and Construction Department's Deputy Vice President for Design advised us that new project design procedures had been drafted and that these procedures incorporate a more intensive review process.

It is too soon to gauge the impact of these procedures, but it is clear that greater attention must be paid to preventing design errors. Since 1989, the proportion of additional work order costs attributable to design errors and omissions has begun to rise (see Table 82). The TA should carefully monitor the impact of the new procedures on design errors and omissions.

Moreover, when additional construction costs are incurred because of design errors, the TA should "backcharge" design consultants who are at fault for these additional costs. In the past, the TA has not always done so. In August 1988, we noted that while hundreds of additional work orders were identified as backchargeable, most had not been analyzed because "the TA lacks the necessary documentation to determine what portion, if any, of the total value of these additional work orders is recoverable."

A year later, our review of the Station Modernization Program determined that the TA had not backcharged design consultants for errors and omissions leading to additional station modernization costs. We attributed that shortcoming to the TA's reluctance to hold its consultants accountable for their mistakes.

During the current review we could not determine the dollar value of additional work orders that design consultants should have been backcharged for, or the amount of money actually recouped, because there is no central file of this information. Instead, it is maintained by individual project managers. Neither the Engineering and Construction Department, nor the Contracts Department monitors backcharges.

The TA has recently increased the threshold at which an errors and omissions study must be performed from \$15,000 to \$50,000. Such studies are performed to determine whether a backcharge is appropriate. We view that change, coupled with the Engineering and Construction Department's failure to monitor backcharges, as a further indication of the TA's unwillingness to hold its consultants accountable for inadequate work.

We believe the TA should aggressively recoup costs caused by its design consultants' errors and omissions. This requires Engineering and Construction Department management to compile an accurate consolidated database of recommended backcharges and to closely monitor whether additional costs are actually recouped.

Unforeseen Conditions. The most common reason for additional work orders was the presence of unforeseen conditions. Although the additional cost of such work cannot be charged to the design consultant, it could, in many instances, be avoided by requiring a more comprehensive site survey during project design.

For example, the Jamaica Maintenance Shop contract called for asbestos abatement in a number of locations. The only asbestos abatement required in the shop's main circuit room involved a 48-foot long overhead pipe. Shortly after work began the contractor discovered that cables running from the circuit breakers were wrapped in asbestos. A \$38,500 AWO was required to correct the problem. Another AWO for \$21,605 was required to remove asbestos in electrical manholes.

A number of signal and communications projects had similar problems with asbestos. Contracts to install telephone cables and related equipment on the "J" Line between East New York and Howard Beach, and on the "A" Line between Marcy Avenue and East New York, had cost increases due to not realizing how much asbestos would have to be dealt with.

In May 1990, TA President Alan F. Kiepper acknowledged in a memorandum to the Capital Program Oversight Committee that adequate field surveys were not routinely performed during project design and that in many cases, especially with equipment contracts, surveys were simply not conducted. He pointed to the Lexington Avenue Line contract as an example of the types of problems that occur when proper field surveys are not performed. That project included such problems as fans which were too large for the chambers they were to be placed in, electrical cabinets intended for spaces so small that there would be no room to perform maintenance, and inadequate asbestos abatement provisions.

While the TA reported in May 1990 that "significant (remedial) actions have already been implemented," we are concerned about the effectiveness of the new procedures. For example, the design for a \$3.4 million contract to stop water infiltration from damaging the tunnel structures along the Brighton Beach Line was prepared between July 1989 and September 1990. O'Brien-Kreitzberg reviewed this contract and found that the design procedures followed by the TA only identified the type and general location of work to be done, rather than providing complete drawings. This approach, according to the consultant, does not adequately define the work in bid documents and makes it difficult to monitor performance and audit costs.

The TA should take steps to ensure that all design work is preceded by thorough field surveys.

Metro-North

Inadequate surveys of site conditions also affected several Metro-North projects. In March 1990, a \$12 million contract was awarded to rehabilitate 15 Hudson Line platforms, repair platform canopies, and build a new pedestrian overpass at Spuyten Duyvil.

According to Metro-North's Assistant Director of Facilities, the mid-Hudson platforms were in bad shape and required repairs costing an additional \$1.5 million, which was not included in the original 1987 budget. According to this official, the design consultant's engineers never went below the platforms to check their condition. Consequently, the extent of deterioration was not known until the contractor looked at the platforms.*

The scope of two bridge rehabilitation projects also had to be expanded because the extent of deterioration was not determined at the outset. The first project called for repairs to two bridges on the Hudson Line at mile posts HU53.00 and HU57.77. The original design merely called for replacing one

* Despite the inadequate initial assessment of deterioration, this project is approximately 18 months ahead of schedule because the contractor is working on all stations rather than just one station at a time. This "production line" arrangement was coordinated with Metro-North officials, who stated that track closures and safety were taken into account in making this decision.

structural component, but now total reconstruction of the bridges' superstructures will be needed. This revision caused a one-year delay and increased project costs from \$600,000 to \$1.5 million.

The second bridge rehabilitation project called for relatively simple structural repairs to two Hudson Line bridges at mile posts HU50.90 and HU68.95. More detailed inspection showed the need for extensive substructure repairs to bridge HU50.90. The budget rose from \$200,000 to \$1.3 million to reflect the added work. In addition, the original design start has been pushed back from June 1991 to June 1992. This project has been temporarily postponed to see how well the work progresses on the first bridge project described above.

Finally, a project to improve drainage on Metro-North's right-of-way near New Rochelle produced a different result from the other inadequate site observations. Originally, this project was budgeted for \$3 million and was scheduled to be completed in March 1991. The project came in \$1 million under budget and was completed in September 1990.

Part of the savings was achieved from reducing the project's scope of work. The Metro-North Maintenance-of-Way Department had claimed that drains were inoperable and had to be replaced with new pipes. However, when work began the pipes were found clogged but still usable. Consequently, new pipes did not have to be installed. Savings were also achieved because less money was needed for flagging and inspection costs.

TRANSIT AUTHORITY LABOR COSTS

A recurring problem addressed in our Station Modernization report was labor cost escalation. These costs include expenditures for work performed by TA employees, such as most track work, and TA support of capital construction projects in the form of flagging, work trains, service diversions, etc. During the current study, we reviewed the impact of this problem on the TA Capital Program as a whole. Progress has been made in bringing in-house labor costs under control, but more needs to be done.

We compared the TA's initial labor cost estimate to the current estimated cost of TA labor at completion for 324 projects managed by the Engineering and Construction Department. Each project was, according to the TA Engineering and Construction Department, at least half finished as of October 31, 1990. The total labor cost overrun for these projects was \$54.2 million, about 21.8 percent of the aggregated base cost of these projects. However, we observed improvement among projects starting between 1987 and 1990. The aggregate labor cost overrun for those projects was about 11 percent of the projects' total costs. For projects getting underway between 1982 and 1986, the aggregated TA labor cost overrun was almost 30 percent (see Table 83).

TABLE 83: TA Labor Cost Escalation, 1982-1990
(\$ in millions)

| Program Category | 1982-86 Labor Costs | | | | | 1987-90 Labor Costs | | | | |
|------------------------|---------------------|--------------|---------------|---------|-------|---------------------|--------------|---------------|---------|-------|
| | No. of Projects | Est. At Base | At Completion | (\$) | (%) | No. of Projects | Est. At Base | At Completion | (\$) | (%) |
| Stations | 39 | \$ 11.2 | \$ 14.9 | \$ 3.8 | 33.8 | 12 | \$ 2.3 | \$ 1.7 | -\$ 0.6 | -26.7 |
| Track | 16 | 37.2 | 43.8 | 6.6 | 17.8 | 8 | 26.3 | 27.9 | 1.6 | 6.1 |
| Line Equipment | 16 | 9.4 | 11.6 | 2.2 | 23.5 | 13 | 25.9 | 28.6 | 2.6 | 10.1 |
| Line Structures | 19 | 31.2 | 34.6 | 3.4 | 10.9 | 9 | 23.3 | 26.2 | 3.0 | 12.8 |
| Signals/Communications | 15 | 28.3 | 46.1 | 17.8 | 63.0 | 5 | 4.1 | 2.6 | -1.4 | -35.3 |
| Power | 16 | 2.3 | 2.1 | -0.2 | -9.6 | 12 | 2.2 | 4.4 | 2.2 | 96.4 |
| Shops | 13 | 4.2 | 5.9 | 1.6 | 36.9 | 9 | 5.4 | 6.4 | 1.0 | 17.5 |
| Yards | 19 | 10.9 | 16.2 | 5.3 | 49.2 | 2 | 3.1 | 3.1 | -0.1 | -2.2 |
| Depots | 18 | 1.4 | 3.9 | 2.5 | 179.0 | 15 | 3.4 | 5.8 | 2.4 | 71.6 |
| Other | 37 | 11.0 | 11.2 | 0.3 | 2.5 | 31 | 5.1 | 5.4 | 0.3 | 5.7 |
| Total* | 208 | \$ 147.0 | \$ 190.3 | \$ 43.3 | 29.4 | 116 | \$ 101.2 | \$ 112.0 | \$ 10.9 | 10.8 |

* May not add due to rounding.

Source: TA Engineering and Construction Department

While TA labor cost overruns appear to be diminishing, they are still excessive in a number of program categories, particularly line structures, line equipment, power, shops, and depots. TA management should determine the reason for these cost overruns and take appropriate remedial measures.

One of the causes of these labor cost increases is project delays. When a project is extended the cost of flagging, work trains, etc., is also extended. Project delays tend to be decreasing, so TA labor cost escalation associated with those delays is also decreasing.

Internal procedures for controlling TA labor costs appear to be lax. In one case, we found that close to \$600,000 in operating expenses had been charged to the Capital Program due to lax internal procedures. The \$17 million project, involving repairs to the Lenox Avenue Line structure from 110th Street to 116th Street, is more than 90 percent complete. This project incurred a TA labor cost overrun of approximately \$3 million. Of this amount, \$600,000 was wrongly charged to the capital program due to problems with the TA's computerized timekeeping system. The TA has indicated that these problems have been corrected and the capital budget has been reimbursed.

The remaining \$2.4 million in TA labor cost overruns was due to an ineffective procedure for ordering trains to be diverted during track work. During track work, the Engineering and Construction Department project manager must arrange for trains to be rerouted with the Rapid Transit Operations Department (RTO). However, there is no mechanism in place for the project manager to know how much these diversions will cost.

In this case, without advising anyone, RTO arranged for more costly diversions than Engineering and Construction anticipated. Consequently, Engineering and Construction was unaware of the additional charges until the project manager received the charge report six weeks after costs were incurred.

The TA should take steps to better track and control in-house labor costs. First, the TA should determine whether operating expenses were incorrectly charged to the Capital Program on any other projects. In addition, a procedure should be devised whereby RTO notifies the Engineering and Construction Department of the cost of service diversions before they actually take place. This will permit discussions in advance regarding less costly alternatives.

LIRR REPRIORITIZATION AND FUNDING SHIFTS

Although the LIRR has completed a number of important capital projects since 1987, its second Capital Program is characterized by frequent large shifts in funds resulting from reprioritizing capital projects. These shifts include the cancellation of several projects, one estimated to cost up to \$162 million, the funding of projects with large budget overruns, and the addition of several new projects.

Following the approval of the 1987-91 Capital Program, the LIRR shifted funds beginning with the 1989 Capital Plan. From 1988 to 1989, the railroad added six new projects and increased the budgets of 13 projects. These increases totaled \$182 million and were offset by reductions in 17 other projects. These funding shifts are shown in Table 84.

Several of the largest changes have been discussed previously. The Hillside Facility received \$27 million in extra funds and Pennsylvania Station received \$19 million. Redesigning the Wreck Lead Bridge required adding \$10 million. Overruns in both the dual mode locomotives and bi-level cars amount to \$16 million. Part of the \$182 million total increase was funded by scaling back the Main Line Third Track project to a smaller project in Mineola. In addition, several projects were dropped from the Capital Program.

TABLE 84: 1988-89 LIRR Capital Budget Shifts
(\$ in millions)

| <u>Additions/Increases</u> | | <u>Deferrals/Decreases</u> | |
|------------------------------------|---------------|-------------------------------------|---------------|
| <u>Project</u> | <u>Amount</u> | <u>Project</u> | <u>Amount</u> |
| Third Track - Mineola | \$ 49 | Main Line Third Track | \$ 73 |
| Hillside Electric Car & Truck Shop | 20 | Jamaica to Valley Signal | 20 |
| Penn Station Improvement | 19 | LIC Storage/Maintenance Improvement | 19 |
| Wreck Lead Bridge | 10 | Jamaica Complex Design | 17 |
| Dual Mode Locomotive | 10 | Bridge & Building Shop | 10 |
| Jamaica To Penn Rev. Signal | 8 | Main Line Electrical | 5 |
| Hillside Phase I | 7 | Station Improvements | 5 |
| Bi-Level Cars | 6 | Other Projects | <u>33</u> |
| New Projects | 26 | | |
| Other Projects | <u>27</u> | | |
| Total | <u>\$ 182</u> | Total | <u>\$ 182</u> |

Source: LIRR Capital Budget Department

From 1989 to 1990 the LIRR Capital Program underwent two major shifts. First, there were \$29 million in increases, and decreases or deferrals of \$29 million were also made. Second, the LIRR removed approximately \$208 million from the Capital Program categories and transferred it to a specially-created reserve category. Most of these reserve funds had been allocated to the Penn Station Improvements project and the Jamaica Station Complex construction project. The reserve category held these funds while project scopes could be reviewed. These funding shifts and the projects included in the reserve category are shown in Table 85.

TABLE 85: 1989-1990 LIRR Capital Budget Shifts
(\$ in millions)

| <u>Additions/Increases</u> | | <u>Deferrals/Decreases</u> | |
|-----------------------------------|---------------|------------------------------|---------------|
| <u>Project</u> | <u>Amount</u> | <u>Project</u> | <u>Amount</u> |
| Hillside Elec. Car & Truck Shop | \$ 20 | Data Center Relocation* | \$ 8 |
| Hillside Phase II | 3 | Penn Station Central Control | 5 |
| Wreck Lead Bridge | 3 | Main Line Third Track Design | 5 |
| Jamaica To Penn Reverse Signaling | <u>3</u> | Hillside Car Wash* | 3 |
| | | Other Project Decreases | <u>8</u> |
| Total | <u>\$ 29</u> | Total | <u>\$ 29</u> |

* Projects canceled

1989: Projects Held in Reserve

| <u>Project</u> | <u>Amount</u> |
|------------------------------|-----------------|
| Jamaica Station Complex | \$ 42.9 |
| Jamaica - Other Construction | 121.7 |
| Richmond Hill Yard | 12.2 |
| Atlantic Viaduct Repair | 7.9 |
| Penn Station Construction | <u>59.0</u> |
| Total Reserve | <u>\$ 243.7</u> |

Source: LIRR Capital Budget Department; 1990 Capital Plan Amendment

From 1990 to 1991 other funding shifts occurred. As shown in Table 86, projects totalling \$211 million were either increased or added to the program. The largest increase was \$78 million added to Penn Station Improvements. Two projects each increased by \$25 million. These increases were completely offset by \$211 million in decreases or deferrals. The largest deferral was the \$162 million for the Jamaica Station Complex Improvements project, a project formerly held in the reserve category. As discussed earlier, the LIRR dropped this project after it decided that operational benefits such as faster trips into Pennsylvania Station would not result from this huge investment.

TABLE 86: 1990-1991 LIRR Capital Budget Shifts
(\$ in millions)

| <u>Additions/Increases</u> | | <u>Deferrals/Decreases</u> | |
|--------------------------------|---------------|------------------------------|------------------|
| <u>Project</u> | <u>Amount</u> | <u>Project</u> | <u>Amount</u> |
| Penn Station Improvements | \$ 78 | Jamaica Station Complex | \$ 162 |
| Atlantic Viaduct Repair | 25 | Richmond Hill Yard | 12 |
| Jamaica To Penn Rev. Signal | 25 | Atlantic Branch Interlock | 7 |
| Bi-Level Cars | 9 | Landia Station | 4 |
| Program Development | 7 | Hillside Phase II | 4 |
| Dual Mode Locomotives | 3 | All Other Projects | <u>13</u> 207 |
| New Projects | 42 | Increased Funding | 4 |
| All Other Projects | <u>22</u> | | |
| Total | <u>\$211</u> | Total | <u>\$211</u> |

Source: LIRR Capital Budget Department

We discussed the 1987-1991 funding shifts and project reprioritization with several LIRR officials including the Executive Director of Capital Program Management, the Assistant Director - Capital Budget, the Chief Budget Officer, the Chief Engineer and the Capital Program's Chief of Technical Services. These officials offered several reasons for the frequent reprioritization.

According to the LIRR's Capital Budget Assistant Director, one cause was tied to the uncertainty in 1986 of funding for a second Capital Program. At the MTA's direction, the LIRR first prepared a three-year program extension and subsequently was directed to extend it to five years. This official indicated that this revision contributed to some projects being poorly defined.

Several other LIRR officials tied the reprioritization during the 1987-91 program to the lack of adequate project scopes and cost estimates in 1987-89. The program's current Executive Director stated that in 1988 he was assigned to oversee a group which reviewed the 1987-91 plan to reevaluate and reprioritize projects based on more refined scopes, designs and budgets.

Inadequate scopes, designs and cost estimates may also have been due to the LIRR's inability to use capital funds for engineering condition surveys prior to establishing a scope, schedule and budget for a project. According to the LIRR's Chief Engineer, until late 1986 or early 1987 the MTA would not allow the railroad to use capital funds for such surveys in a preliminary manner. He indicated that this led to problems in estimating the extent of needed repairs on existing facilities.

LIRR officials pointed to repeated changes in the railroad's management as contributing to the shifts in direction of the Capital Program. Noting that there have been four LIRR presidents during the past nine years,* the Capital Program's current Executive Director indicated that each change resulted in shifts in the program's organization and in its leadership. He said such reorganizations contributed to the program's changing priorities.

Also contributing to reprioritization were federal and state mandates and pressures from elected officials and other external forces. Program shifts were necessitated by new laws or regulations affecting underground fuel tanks, asbestos, access for the disabled and train speed controls. Inclusion of a new train station in the Capital Program was cited as an example of a project resulting from outside pressure.

Perhaps the most direct pressure affecting the shape of the LIRR's Capital Program came from UMTA. Dissatisfied with the results of the LIRR's Capital Program, UMTA held up Federal funds in early 1989. In a March 1989 letter to MTA Chairman Robert Kiley, UMTA Administrator Alfred DelliBovi called on the LIRR to address its "chronic managerial difficulties" DelliBovi listed eleven points needed to correct deficiencies in project management, quality assurance, scheduling, cost control, force accounts and management reports. The letter also stated that until the railroad could successfully show that it had implemented these corrective measures, UMTA would not consider the LIRR "technically capable to manage UMTA grants"

Responding to UMTA's directive, Kiley began a series of reports to UMTA in April 1989 outlining the steps taken by the LIRR to address DelliBovi's concerns. After an initial report of program initiatives, DelliBovi replied that funding may not be resumed by the end of 1989 as Kiley expected. DelliBovi wrote that

in addition to establishing various control systems and management techniques, the LIRR must demonstrate actual and viable implementation of same in order to be considered eligible for future UMTA funding.

DelliBovi tied the need to improve managerial processes to numerous quality control, scheduling and cost difficulties. He stated that the LIRR's inability to adequately manage its projects have led to delays or continuous cost overruns. DelliBovi wrote Kiley: "Such cost overruns in these and other projects have resulted in the elimination of other worthwhile projects from the LIRR's capital program."

* Robin Wilson was the LIRR's President from the inception of the Capital Program until February 1985; Bruce McIver was President from February 1985 to September 1989; Peter Stangl then served as Acting President until Charles Hoppe became President in April 1990.

To address UMTA's concerns, in early 1989 the LIRR brought in a new Capital Program Director and began reorganizing its management of the program. According to the Chief of Technical Services, the goal was to replace the existing inadequate system with an up-to-date management structure. Prior to 1989, the management style was characterized by loosely followed, vague and poorly documented procedures. Duties were poorly delegated and project managers were not always aware who was charging costs to their projects. Well-defined schedules were not followed. These problems arose because the Capital Program lacked the necessary checks and balances and lacked written procedures.

Part of the Capital Program reorganization was directed at improving project scopes and budgets. A Scope and Budget Group was formed to redefine scopes and budgets of existing projects less than 95 percent completed. This group also refined scopes and budgets for all future capital projects.

To further address UMTA's concerns, the LIRR created new or expanded units within the Capital Program Management organization. A Quality Assurance Unit was created to assess the overall quality of procedures and a Technical Services Group was formed to improve several efforts including financial controls, scheduling and estimating, capital program reports and computer support services.

The officials we spoke with agreed that since 1989 the LIRR Capital Program has "put its house in order" and is now being managed with the necessary controls and checks and balances. They indicated that these types of controls would have prevented the mistakes made during the start of the 1987-91 Capital Program. Changes to project scopes are now controlled by requiring approval of three top LIRR executives; formerly, project managers and middle-level managers could authorize project scope changes.

LIRR officials also believe that the current method of reviewing potential projects for the proposed 1992-1996 program will avoid past problems caused by lack of operating department input and inadequate preliminary engineering work. By controlling project scopes and budgets, the railroad would avoid budget overruns such as resulted with Hillside, a project which was likened to a "shark" which devoured many smaller projects.

The changes which the LIRR has implemented since 1989 have the potential to prevent recurrence of the problems which led UMTA to withhold federal funding. We urge MTA and LIRR Capital Program staff to closely monitor the budget and priority-setting process so that funding for LIRR capital projects is never again jeopardized.

DELAYS DUE TO AGENCIES OUTSIDE THE MTA

This report has focused primarily on delays caused by internal factors, such as changes in design, unforeseen site conditions, and changing priorities. Delays have also been caused by the intervention of outside agencies, such as the DEC, New Jersey Transit, and not-for-profit corporations. While such delays may sometimes be beyond the MTA's control, it is important to devise ways to minimize their adverse consequences.

Metro-North

Department of Environmental Conservation. The New York State Department of Environmental Conservation has played an important role in regulating, approving, and monitoring Metro-North's capital projects. Because of DEC's close scrutiny, environmentally-sensitive projects have sometimes experienced delays and cost increases. In most cases, these delays were caused by the need to obtain permits and devise environmentally sound construction methods.

- Additional studies and tests required by DEC delayed the completion of the Harmon Lagoon Clean-Up Project's study from December 1990 to December 1992. The cost of the study increased from \$4.9 to almost \$6 million and the clean-up itself, expected to cost an additional \$12 million, will extend into the proposed 1992-96 Capital Program.
- The Harmon Shop Fire Protection/Roof Drain Separation project had to be redesigned as a result of DEC concerns.
- The sewage treatment plant at Brewster Yard was another project delayed by DEC. Discussions between Metro-North and DEC over how to proceed have been going on since the 1982-86 Capital Program.
- The Port Jervis Yard Oil/Water Separation Facility may be delayed while Metro-North takes steps to comply with DEC requirements. DEC officials fear that dumping by local residents may prevent the planned separator from functioning properly.
- The Harmon Material Storage Facility project was delayed while Metro-North waited for a DEC construction permit.
- Metro-North constructed new waste storage facilities at several shops to comply with DEC requirements. With the new facilities, the railroad will be in full compliance with DEC requirements for safe waste storage. This small unplanned project is expected to cost \$400,000.

A Metro-North official told us that the railroad may not have been as environmentally sensitive as it should have been in the past, but that steps have been taken to minimize any adverse environmental effects of the railroad's actions.

According to Chairman Kiley's 1990 report to the Governor, "pollution removal is a priority of the Safety and Capital Programs departments" Metro-North has also begun to submit proposals to DEC for approval before construction contracts are awarded to facilitate environmentally sensitive projects.

New Jersey Transit. Metro-North is working with New Jersey Transit (NJT) to expand service on the West of Hudson lines. Phase I of the West Shore Design and Engineering Project, which was completed on time and within budget in 1989, estimated passenger demand, identified station sites, evaluated possible terminus points, and defined design characteristics for a new service. Phase II involves preliminary design work, more refined cost estimates, and an environmental analysis. Metro-North's work is on schedule and within budget, but NJT is reexamining its capital priorities and budget. Metro-North is waiting for NJT to indicate that it is ready to initiate preliminary engineering.

A similar situation has developed over a study to evaluate improvements on the Port Jervis and Pascack Valley lines. The project is three months late due to concerns on the part of New Jersey Transit.

New York State Department of Transportation. Metro-North awarded a \$1.3 million consultant contract in September 1989 to study the feasibility of a rail bridge or tunnel between Orange or Rockland and Dutchess, Putnam or Westchester counties, and the feasibility of providing rail service to Stewart Airport from existing or proposed connections.

This project is approximately six months behind schedule. Metro-North's project manager explained that the delay is due to a request by the New York State DOT to alter the project's schedule to coordinate it with DOT projects involving Stewart Airport and a high occupancy vehicle lane on I-287 in Westchester County.

Municipalities. In 1989, Metro-North provided \$20 million to construct additional parking spaces to increase peak and off-peak ridership. Under this policy, the MTA will pay up to half the cost of new parking facilities at stations. On land currently owned by the MTA the funding may be as much as 100 percent. The parking program was set back because several communities are still undecided as to whether or not they will participate in the program. In several other cases, legal problems still need to be negotiated between Metro-North and the municipalities.

Eighteen communities responded to Metro-North's solicitation for 50 percent involvement. Out of the 18, four lots have been completed and four municipalities have withdrawn from the program. The remaining ten are still in negotiations.

Long Island Rail Road

The LIRR's Wreck Lead Swing Bridge project was initiated during the 1982-86 Capital Program. It called for replacement of the wooden trestle and railroad bridge over the Reynolds Channel in Island Park, Town of Hempstead, with a bridge purchased from a Florida town. The old bridge had to be replaced because it was so deteriorated it was no longer reliable.

Originally, the LIRR intended to put the bridge where the old bridge crossed the existing channel. The Town of Hempstead, however, with the U.S. Coast Guard's concurrence, forced the LIRR to change the location of the bridge to the center of the channel. The old bridge had been in the deepest part of the channel, but close to shore, causing a potential hazard to boat traffic. The new site required a longer structure than the old site, so the new bridge had to be redesigned.

The project had to be completed in five months or the Coast Guard would have refused permission for the LIRR to continue construction because the pleasure boats in the area had to have access to the waterways by the beginning of the summer season. To complete the construction, crews worked round the clock, incurring massive amounts of overtime. The cost of the project doubled from \$14.9 million to \$28.5 million.

UMTA Funding Suspension

From late 1989 to early 1990, uncertainty regarding the receipt of Federal funding for capital projects caused the MTA to delay a number of projects and postpone others to the proposed 1992-96 Capital Program. Five Metro-North projects and nine Transit Authority projects (seven of which comprise the Astoria Line Rehabilitation) were affected by this delay.

The Urban Mass Transportation Administration provides Federal funds for capital projects to the MTA. For the entire 1982-91 Capital Program, it is anticipated that UMTA will make over \$4 billion available to the MTA. To qualify for UMTA funding, a grant application must be made, public hearings held, and the comments received at the hearing evaluated. Based on this process, grants are either approved or rejected. Grants are usually awarded bi-annually, but a Metro-North Capital Program official told us that delays are normal. Considerable time can pass between applying for a grant and actually receiving it.

However, in late 1989 MTA's relationship with UMTA became uncertain because UMTA was "between Administrators." In an October 11, 1989 memo to two top Transit Authority and Metro-North officials, the MTA's Director of Capital Program Management warned that UMTA funds would probably be delayed through the end of 1989 and perhaps into early 1990. Due to this uncertainty, some projects were delayed, bid openings for recently advertised projects were postponed, and several other contracts scheduled to be awarded during 1989 were deferred.

Nine TA projects were affected by these directives. A project to replace platforms, roofs and canopies on the Dyre Avenue Line was advertised, but the award of the contract was delayed. The bid opening for signal system modernization on the Brighton Line was postponed. In addition, bid openings for seven projects connected with the rehabilitation of the Astoria Line were also postponed. The MTA expected that it would reapply to UMTA for funding for these seven projects.

Five Metro-North projects were affected by the delay in receiving UMTA funds. Bid openings were delayed for mid-Hudson station improvements, reconfiguration of the Mott Haven interlocking, rehabilitation of the Yonkers Viaduct, and the second phase of a project to replace electric feeder cables in Grand Central Terminal. Metro-North was also forced to postpone the bid opening for the New Haven Line Catenary project and eventually deferred it to the proposed 1992-96 Capital Program. This caused a one-year delay in the project.

Transit Authority

The Manhattanville Bus Depot was also delayed by outside agencies. The Manhattanville Depot was to replace the 132nd Street Depot, which closed in 1986. TA engineers began design for the depot foundation in August 1986. After the design was 40 percent complete in April 1987, the Harlem Urban Development Corporation (HUDC) proposed building housing over the depot. By July 1987 the MTA and HUDC agreed that a 25-story apartment building would be built above the new depot. New designs cost the TA an estimated \$700,000. HUDC was to reimburse the TA by November 1987 for any additional design and construction work.

Failing to be reimbursed, the MTA decided to build the depot using the TA's original design. When construction of the foundation began in 1988, HUDC again requested building the apartments. The MTA directed the TA to halt all design and construction activities. A compromise was reached in March 1988 to set the depot back 130 feet from 12th Avenue so that an apartment house could be built on the site. The MTA then instructed the TA to resume constructing the depot's foundation. The foundation was completed in November 1989 and structural steel work was finished in June 1990. The final construction phase is set for completion in June 1992, approximately one and a half years beyond the original completion date of October 1990.

While these types of delays are often not within their direct control, we recommend that the MTA and its constituent agencies explore ways to minimize delays caused by outside agencies. Such efforts could include additional community outreach, better liaison with other government agencies, advance planning with state environmental officials, and stronger commitments from funding partners.

SECTION FOUR: CONCLUSION

Summing up what he saw as the condition of the MTA system, then-MTA Chairman Richard Ravitch declared in late 1980 that everyone could see that it was "deteriorating at an accelerated rate." The MTA staff estimated that \$14 billion was needed over the next ten years to achieve what Ravitch called the "one simple objective" of the MTA's revitalization plan: "to restore the system to a state of good repair so that we can provide the quality of service the public wants and to which it is entitled."

In September 1981, the MTA began its first five-year Capital Program to reverse the effects of deferred maintenance. As we have described in some detail in Section Two, funds were secured to maintain, modernize and upgrade the subway, bus and commuter rail systems' vital components to a state of good repair. The 1981 Capital Plan warned of the danger to mass transit if this goal was not achieved:

A failure to accomplish these objectives will surely lead first to increased passenger discomfort, then further deterioration of the system, increased unreliability, and finally an absence of proper levels of safety. Any safety risks will result in gradually shutting the system down, for we will not operate an unsafe system.

By the end of 1991, the MTA will have allocated over \$16 billion to restore its deteriorated transit system and to provide improvements and other enhancements to lure new riders. However, noting that \$12.3 billion had enabled the Transit Authority to buy new subway cars and buses and to upgrade over 700 miles of track, in May 1991 TA officials cautioned that the work of reviving the TA's system is not quite half done. They specifically identified stations, signals, water pumps, ventilation fans, tunnel lighting, power substations, depots, yards and shops as infrastructure and equipment that is well beyond their normal life expectancies.

Obtaining the necessary funds to continue to restore the system is likely to be more difficult than in the past. First, money is scarce. The city, state and federal government are in the midst of a recession. New York State and New York City have both had to severely cut their budgets, and after several years of growth, MTA ridership has begun to decline, a trend primarily attributed to the weak economy in the New York region.

There is another reason why securing additional funds may be more difficult. In the past, riders could easily see the deterioration in the condition of the aging subway and bus fleets, and in the numerous derailments, fires and other dangerous incidents. After a decade of spending, the needs are not so obvious. As the TA itself recently acknowledged, the "subway's aging line equipment (like tunnel lighting, signals, fan plants, and water pumps) gets attention only when it fails during an emergency."

Recent emergencies such as the December 1990 fire at Clark Street and the 1990 near-closure of the Nevins Street Station illustrate how "hidden" needs, such as tunnel ventilation fans and station structural supports, can become visible when a catastrophe is narrowly averted. These two incidents raise fundamental questions for policy-makers as they debate the funding needed and the priorities sought by the MTA for its proposed 1992-1996 Capital Program:

- o Has the MTA achieved its goal of achieving a state of good repair?
- o If not, when will a full state of good repair for the system be achieved?
- o How should the MTA structure its third Capital Program to meet its most pressing priorities?

In 1980, the MTA estimated that it could attain a state of good repair for the mass transit system (TA, Metro-North and LIRR) by 1990. Over the past decade, the time needed to achieve this goal has stretched farther and farther into the future. The MTA now estimates that even if it receives the funds it seeks for its proposed 1992-1996 Capital Program, some major system components will not be in a state of good repair until the second decade of the 21st century.

Because relatively little emphasis was placed on rebuilding certain parts of the infrastructure or because agencies sometimes gave more importance to cosmetic concerns than structural integrity, it will take several more capital programs to achieve Ravitch's prime objective. We support the goal of improving the aesthetic environment experienced by millions of passengers daily. But we do not wish to see a return to conditions that then-MTA Chairman Kiley called "an arena of devastation," a situation caused by years of failing to keep structures and equipment in good repair.

The TA, especially, has not met its schedule to bring stations, shops, yards, and such infrastructure items as line equipment and its signal system to a state of good repair. According to the TA's own projections, stations will take until 2009, 16 years later than the goal set in late 1983. Similarly, shops will take until 2006, 18 years later; yards will achieve good repair in 2014, 20 years later; for line equipment (tunnel fans, pumps and lights) the date is 2006 instead of 1993; for signals it is 2012 rather than 2003. The commuter railroads' line structures will take until 2011 to reach a complete state of good repair, and Metro-North's stations and shops will take until 2006.

Obviously, the MTA is not where it planned to be when the Capital Program was launched a decade ago. Large portions of the system have not been brought to good repair, and different priorities have taken attention away from the "simple objective" of 1980. With public resources in short supply and with heightened competition for limited funds, policy-makers must make difficult choices as they assess the MTA's proposal for rebuilding and reinvigorating the region's mass transit.

Restoring aging structures and equipment to good repair is not the only legitimate aim of the MTA's Capital Program. Enhancing the safety and security of passengers and employees and providing a more pleasant environment are also critical objectives. In addition, the MTA must continue to seek ways to increase revenue through additional ridership, improve productivity and curb fare evasion. The Capital Program is important for all of these initiatives.

We agree with MTA Chairman Stangl's appraisal that capital investment in the region's mass transit system must continue because if it does not, the system will deteriorate as it did during the late 1970s. He recognizes that the current fiscal crises at all levels of government and within the MTA must not obscure the remaining needs for transit customers and employees.

However, we are concerned that repeating mistakes of the past will limit the MTA's ability to carry out the main objective of its capital rebuilding effort. In our review we found examples of inadequate project planning and design which led to cost overruns, project delays, numerous change orders during construction, and, in some cases, even project deferrals or cancellations. Some of these are due to the same kind of deficiencies which caused similar problems in the past. Now with resources so scarce, it is imperative that MTA agencies subject every project to careful scrutiny from initial survey, to scope and design and final contract close-out.

As our examination of TA labor costs indicated, more should be done to monitor and control costs. There is no excuse for using the capital budget to absorb costs that are more appropriately funded from the operating budget. Keeping projects on schedule to avoid extra costs caused by delays is another way that managing the Capital Program could be improved. Such delays cause administrative and consultant costs to mount and adversely impact resources which should be used to implement new projects.

We also believe that more should be done to limit the number of additional work orders caused by design errors and omissions. While only about 9 percent are reported to be due to design mistakes, that percentage may not reflect many of the additional work orders linked to unforeseen field conditions. In addition, no system is in place to record the extra costs to be recovered from consultant errors and the money actually recouped. These deficiencies stem from a general reluctance by TA managers to hold design consultants accountable for their mistakes. We strongly urge the MTA and TA to adopt and enforce a policy which holds design consultants and contractors responsible for their errors.

We are troubled by the fact that neither the TA's 1982-86 nor the 1987-91 Capital Programs were prepared with the benefit of complete and accurate information about the condition of the TA's facilities and equipment. Such information is absolutely essential to an informed setting of priorities and a realistic estimation of the costs involved. Because condition surveys were not conducted prior to starting construction work, such program areas as track, stations and line equipment have had their funding increased to meet unexpected needs at the expense of shops, yards, signals and depots projects.

While problems facing the Capital Program, such as delays in funding or requirements imposed by other government agencies, are not within the direct control of management, checking the condition of physical assets before setting priorities and planning specific projects surely is. The success of the Capital Program requires, at a minimum, an accurate assessment of the condition of these facilities, along with a realistic estimate of the costs involved. A failure to obtain this information during the planning stage not only jeopardizes the success of the program, but has the potential to seriously affect the reliability and safety of subway, bus, and commuter rail operations as well.

We believe the MTA must also do a better job of calculating the benefits its new initiatives will produce and the costs to achieve them. Our review of the cost-benefit analysis for the planned AFC system, for example, shows that inadequate assessments can result in policy-makers making decisions based on faulty or incomplete information. Such studies must be carefully reasoned, backed by sufficient empirical evidence and rigorous analysis, and publicly discussed before huge sums of public money are committed.

This report refocuses attention on the underlying purpose of the capital revitalization effort and calls attention to shortcomings which we believe must be addressed as the MTA embarks on a third five-year Capital Program. Attaining a state of good repair for the entire system is as relevant today as it was in 1980. That many of today's needs are less visible because they are underground or behind walls or ceilings does not make them any less essential.

Amid competing priorities and severe budget restraints, decision-makers must judge the adequacy of the MTA's plans to bring its entire transit system to a state of good repair. And Capital Program managers must seek better ways to assess the condition of facilities and equipment, keep projects on schedule, control costs, and evaluate new capital project initiatives.

Although the MTA's Capital Programs have produced major accomplishments, there is still much work to be done and problems to be addressed. We believe that by implementing the recommendations in this report, the work done under the next Capital Program will be better managed and the public's investment in rebuilding our public transportation system will be better protected.

APPENDIX A

MTA RESPONSES TO DRAFT REPORT

347 Madison Avenue
New York, NY 10017
Telephone: 212 878-7000

September 27, 1991

Mr. John S. Pritchard III
Inspector General
Inspector General Office
100 Park Avenue - 14th Floor
New York, NY 10017

Re: MTA/IG 91-12

Dear Mr. Pritchard:

This is in response to your draft report which reviewed the MTA Capital Program.

I have enclosed a copy of the responses prepared by each respective Agency Head as well as the MTA Capital Program Management Department which responds to your report in detail. For the most part, it is our assessment that the report is a fairly accurate appraisal of the progress made by the MTA in meeting the objectives of the first two Capital Plans as well as presenting a balanced view of each agency's accomplishments and shortcomings.

One major concern, however, which we believe needs to be addressed relates to the conclusions reached with respect to restoring our physical plant to a state of good repair by the end of the second Capital Program. It is our position that these conclusions are off base since they are predicated on the use of a 1980 study which stated that all state of good repair needs could be eliminated in 10 years. As explained in the attached response that was prepared by the MTA Capital Program Management Department, the 1980 Needs Assessment was prepared under extreme time constraints, thus not allowing the opportunity to fully evaluate both the cost and length of time it would require to bring our systems to a state of good repair. A more detailed Twenty Year Capital Needs Assessment (1987-2006) was prepared in 1986 which presents a more

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Lucius J. Riccio
Joan Spence
Edward A. Vrooman
Robert F. Wagner Jr.
Alfred E. Werner

Mr. John S. Pritchard III
Page two
September 27, 1991

realistic assessment of the time and resources needed to restore those systems to a state of good repair. These estimates were reaffirmed in 1990 by an updated Twenty Year Needs Study which produced results that were comparable to the 1986 study. Therefore, it is our belief that the 1986 Needs Assessment provides a more accurate measure as to our performance in meeting the objective of bringing our systems to a state of good repair and would recommend that this Assessment be used as the basis for any such comparison.

Thank you for the opportunity to respond to this draft report.

Sincerely,

Peter E. Stangl
Chairman and
Chief Executive Officer

enclosures

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Responses to the Inspector General's Review of the Metropolitan Transportation Authority Capital Program.

Responses prepared by MTA Capital Program Management Department

Pages 19,20,23 - Comments on 1980 MTA Capital Needs Assessment's estimate of the cost to achieve a State of Good Repair at the Transit Authority and on TA estimates of the length of time it would take to reach a State of Good Repair for system components.

Response:

The Inspector General's review of the MTA Capital Program states that in 1983 the MTA estimated that the TA would have to spend \$12.5 billion to restore the transit system to a state of good repair by the end of the decade. The review points out that "This estimate of how much would have to be spent has proven to be far too low."

A number of comments are required here. Firstly, while it is possible that the initial estimate of the cost of achieving a state of good repair at the TA may have been too low, there may be an "apples and oranges" issue here. Comparing state of good repair estimates in the 1980 Needs Assessment with the Needs Assessments done in 1986 and 1990, which were for 20 years rather than the 10 years in the 1980 Assessment, must be done with care.

Even if such a comparison showed that the state of good repair estimates in 1980 were too low, however, this is not necessarily relevant at this time. The initial 1980 assessment was done in a time of crisis (as the IG review notes). At this time, staff was working quickly to come up with initial estimates of the needs. After the first plan was approved, and particularly for the preparation of the second plan for 1987-1991, however, more detailed needs assessments were carried out. These more detailed analyses were reflected in the Twenty Year Capital Needs Assessment for 1987-2006, issued in November 1986. These 1986 estimates, of both cost estimates and the length of time it would take to reach a state of good repair, have proven to be sound. Moreover, the 1990 Capital Needs Assessment for 1992-2011, prepared for the third plan, and the 1986 assessment are in basic agreement.

The point that is being made here is that the more detailed analyses that were carried out at the behest of MTA and TA management subsequent to the approval of the first plan have proven to be accurate statements of the TA's long-term capital needs. In this respect, it also should be noted that these more detailed analyses indicated that, if anything, the initial cost estimates had been too low and the length of time it would take to reach a state of good repair too optimistic. No one has disagreed with these findings. More careful assessment of the TA's capital needs has produced more accurate and more refined cost estimates. This is understandable given the emergency situation in which the first Needs Assessment was prepared.

These more detailed assessments have also produced a more realistic schedule for achieving a state of good repair. The Inspector General's review notes, in this regard, that in 1983 the TA predicted that a large portion of the transit system would reach a state of good repair by 1990. After taking office in 1984, however, the administration of TA President David Gunn reviewed these estimates and found some of them to be unrealistic. Again, the point is that detailed analysis done subsequent to the initial reports showed that the effort to reach a state of good repair was more complicated than had initially been

perceived. One thing that was not taken account of in enough detail, for example, was the impact of heavy rehabilitation work on passenger operations. Since the transit system must be kept operating 24 hours a day, any work on the system's right-of-way, including signals, line structures, etc, must be spaced out over time to minimum service disruptions. After the TA review, the state of good repair dates for almost all TA categories of work were pushed out beyond the original estimates made by the TA in 1983 (page 23 the IG review). With some major exceptions, however, the 1986 dates are in general agreement with the current (1991) estimates.

Page 232, third paragraph. Comment on the possibility that inadequate scopes, designs and cost estimates for LIRR projects might be due to the Railroad's inability to use capital funds for engineering condition surveys.

Response

This comment, allegedly by the LIRR's Chief Engineer, makes little sense. Firstly, whether or not the MTA Capital Program paid for condition surveys, it is difficult to understand how the Railroad could determine for itself the extent of needed repairs, and the scope of work necessary to remediate this situation, without first performing a condition survey. That is, it would simply be unprofessional to proceed with such work without such a condition survey no matter who was paying for it.

Secondly, it should be noted that MTA does not preclude "condition surveys" from being funded through the Capital Program. The only requirement is that they be project specific, for either a project funded in the current program or for a project proposed for a future program. MTA considers it prudent engineering judgement to perform a detailed survey or inspection to determine the condition of a facility before starting design for such a rehabilitation. Generic type inspections, inventories or surveys or those which are done routinely for maintenance purposes (not funded from the MTA Capital Program), however, are not capital eligible.

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APPENDIX B

TRANSIT AUTHORITY RESPONSE TO DRAFT REPORT

370 Jay Street
Brooklyn, NY 11201
Telephone 718 330-4321
Fax 718 596-2146

Alan F. Kiepper
President

September 20, 1991

Honorable Peter E. Stangl
Chairman and
Chief Executive Officer
Metropolitan Transportation Authority
347 Madison Avenue
New York, NY 10017

RE: MTA/IG Report 91-12
Review of MTA Capital Program

Peter
Dear Chairman Stangl:

A review of the MTA/IG Report 91-12 entitled, Review of the MTA Capital Program has been completed and the attached summary outlines the NYCTA responses.

Due to the relatively short time frame allotted for this review, our reply focuses on major IG findings and recommendations.

It should be noted that many of the exhibits can't be independently verified, due to multitude of sources referenced.

Should you require any additional information concerning our responses, please contact Jerome Forman, Senior Vice President - Capital Program Management at (718) 260-0450.

Sincerely,

Alan F. Kiepper
President

Members of the Board

Peter E. Stangl
Chairman and
Chief Executive Officer
Daniel T. Schanell
First Vice Chairman

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Richard T. Wash
Lucius J. Riccio
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Alfred E. Weiner

**TRANSIT AUTHORITY COMMENTS TO
MTA/IG REPORT 91-12
REVIEW OF THE METROPOLITAN TRANSPORTATION
AUTHORITY CAPITAL PROGRAM**

The findings and recommendations have been grouped by subject matter to facilitate review.

I. General:

Section One: Introduction (The following are proposed revisions to statements made in Section 1)

IG Statement: (page 3 of IG Report)

"The 1992-1996 Capital Program document must be submitted to the State Legislature by October 31, 1991."

TA Comment: The 1992-1996 Capital Program document must be submitted to the State Legislature by October 1, 1991.

IG Statement: (page 3 of IG Report)

"The TA's buses, track, and subway cars will be in a state-of-good-repair by 1996."

TA Comment: Current schedules indicate that buses, tracks, and subway cars will be in a state-of-good-repair by 1992. In fact, buses were put in a state-of-good-repair in 1986 and track will be in SOGR by the end of 1991. Subway cars will be in a state-of-good-repair by the end of 1992.

II. Budgetary Issues:

IG Statement: (page 12 of IG Report)

"The TA will actually commit about \$127 million less than the amount planned in 1987, but this relatively small overall budget decrease masks major changes between 1987 and 1991. A large number of projects have been deferred; 193 projects worth \$1.7 billion were deferred while 307 projects worth \$1.1 billion were added. The remaining projects tended to increase in cost; a \$608 million increase in the cost of all other projects accounts for the difference between projects added and projects dropped.

As a result, many of the improvements originally included in the 1987-91 TA program were deferred."

IG Statement: (page 14 of IG Report)

"The TA's 1982-86 and 1987-91 Capital Programs were prepared without the benefit of complete and accurate information about the condition of the TA's property, facilities, and equipment as a result, the TA had to redirect funds and alter priorities on a number of occasions. Categories such as track, stations, and line equipment have had funding levels raised to meet unexpected needs; this has delayed the repair of shops, yards, signals, and depots."

TA Comment:

The experience of the 1987-1991 Capital Program demonstrated the necessity for the Authority to improve the level of its project scopes and resulting cost estimates for capital projects. In 1987, detailed project scopes did not exist prior to the beginning of design. This lack of detailed project information resulted in the understatement of project costs. The Transit Authority has substantially improved its performance in this area. In preparation for the Third Five Year Capital Program, the Authority undertook a comprehensive Twenty-Year Needs Assessment, utilizing all current inventories and condition surveys which are now available for most major asset groupings and a broad history of project implementation in all asset subcategories. Additionally, the Authority has put in place more realistic project cost estimates which are based on experience, market conditions and allowance for indeterminants. In addition, pre-design scope reviews for projects to be awarded in 1992-1993 are being developed to improve the project scope development and budgeting process. Based on experience and better inventories and condition surveys, the Authority expects to implement the Third Five Year Capital Program with close adherence to budget and schedule goals.

IG Statement: (page 12 of IG Report)

"Six of ten yard rehabilitations and expansion projects were deferred."

TA Comment:

Although yard rehabilitation projects have been deferred based on Authority priorities, the in-house yard track program has performed the necessary repairs and reconstruction to yard track at two major yards, Coney Island and East New York.

The Authority in its 1992-1996 Capital Program will continue to make the necessary yard investments to support its car fleet. This will include yard track rehabilitation at the 38th Street Yard as well as a comprehensive yard track and switch rehabilitation program. However, due to 1992-1996 Capital Program funding constraints, the Jamaica Yard Expansion was deferred to a future capital program.

IG Statement: (page 12 of IG Report)

"Two of four "Key" station modernization (Times Square and the Atlantic Terminal Complex) were deferred."

TA Comment:

The Authority has not deferred the Times Square Station Modernization from its 1987-1991 Capital Program, although it was listed as deferred in the report. However, this project has experienced delays in conjunction with the private development of the site which may delay the projects award beyond December, 1991. In the 1991 Plan Amendment, the Transit Authority recognizes the uncertainty surrounding the timing of the Atlantic Avenue Development Project, including the configuration of nearby streets, and takes advantage of this delay by including funds for the development of a master plan for the Atlantic Avenue Complex. This master plan will ensure that the project is comprehensive and compatible with development, and will address the issue of intermodal

facilities. The MTA Real Estate and Planning Departments, in conjunction with the Transit Authority and the Long Island Rail Road, will develop a master plan for this site. Implementation of the plan will begin in the 1992-1996 Capital Program. In addition, the Transit Authority plans to proceed immediately with the renovation of the Pacific Street Station platforms, which will not be impacted by the Atlantic Avenue Development project.

IG Statement: (page 12 of IG Report)

"Three of six new depot construction projects were deferred. Three of eleven depot rehabilitation projects were deferred."

TA Comment:

The primary emphasis of depot investments in the first two Capital Programs was on replacing or rehabilitating the most seriously deteriorated depots. Of the three new depot construction projects deferred, two projects were actually base maintenance shops. The other project, Hudson Depot Replacement, was substituted with the West Side Depot. At that time, property acquisition for the Westside Depot was part of the Authority's April 1991 Capital Program. This acquisition however, was subsequently deferred to the 1992-1996 Capital Program because of a reduction in funding resulting from postponement of the sale of the Coliseum. Bus Base Maintenance shops perform heavy overhauls and major repairs for the bus fleet as opposed to depots which provide primarily bus storage and routine maintenance. The Transit Authority is currently working with a consultant to evaluate the agency's base maintenance shop requirements and to develop an efficient base shop strategy. The 1992-1996 Capital Program includes \$116 million to accommodate Base Shop initiatives.

IG Statement: (page 12 of IG Report)

"The rehabilitation of the 207th Street Shop, one of the TA's two car overhaul facilities was deferred."

TA Comment:

In 1988, the Transit Authority experienced an unfavorable bidding climate. On average, bids were 20% over budget. The 207th Street Overhaul shop was deferred in 1988, after bids for this facility were received that were \$20 million over budget and only two qualified bidders responded. Also, at that time, the Transit Authority determined that the potential existed for disruption to shop operations, because the Coney Island overhaul shop was under construction at that time.

Since 1988, the Transit Authority has reevaluated its shop requirements. In order to accommodate the Transit Authority's new SMS program in the 1992-1996 Capital Program, it was determined that it is more efficient to rehabilitate three of the existing car maintenance shops instead of a comprehensive rehabilitation of the 207th Street Overhaul facility. In addition to necessary repairs to achieve a state-of-good-repair, the E. 180th Street and 240th Street Maintenance Shops will also be rehabilitated to accommodate the maintenance requirements of the new technology trains, while the rehabilitation of the 207th Street Overhaul Shop was deferred from the 1992-1996 Capital Program.

IG Statement: (page 13 of IG Report)

"Because of these deferrals, TA efforts to achieve a state-of-good-repair have had mixed results. The TA has restored its buses, subway cars, and mainline track to a state-of-good-repair, but its efforts elsewhere have not been as successful. The TA's Timetable for achieving a state-of-good-repair has slipped substantially."

TA Comment:

In 1986 the Authority conducted a Twenty Year Capital Needs Assessment 1987-2006. The findings and recommendations for achieving state-of-good-repair for Authority investments were based on a more extensive evaluation of existing equipment and facility conditions and their average life expectancy. Based on these findings in 1986, the Authority's state-of-good-repair goals were revised to be consistent with the best available information at the time.

Although some investment areas will experience further delays, the findings of the 1986 assessment are generally consistent with the current estimates.

III. Construction Administration Costs

IG Statement: (page 13 of IG Report)

"Increase in construction administration costs of \$70.1 million or 17 percent during 1987-1991 period. TA design costs also increased by \$94 million (41 percent)."

TA Comment:

Design

Contingency funds specifically designated for the design of 1992-1996 Capital Program Projects were utilized in 1990 and 1991.

The numbers have assumed that the increase was based on preestablished budget using 1987 (Base). When in fact, the contingency design funds were established in anticipation of funding needs for the design of 1992-1996 Capital Projects.

91% of the increase in design (\$86M) occurred in 1991. This increase is directly attributable to the design of the first two years of the 1992-1996 Capital Program. In 1987, a nominal \$30 million was budgeted in 1991 for design of any future program. In addition to the 1992-96 program, 1991 awards were added to the 1987-91 program which required design in 1991.

Construction

There is certain validity in the assertion that increased construction durations will have a proportionate increase in construction administration costs.

However, the attached analysis of construction durations Figures 1 and 2 indicates that construction durations for the period 1987 through 1990 are within acceptable limits.

The construction administration estimates in 1987 represented 8% of their associated construction costs. Historical data indicates that construction administration averages 11-12% Authority-wide. Therefore, the estimates were likely understated at that time.

IG Recom.No. 4:(page 17 of IG Report)

The TA should act to better control construction administration and design cost increases resulting from prolonged project delays and other causes.

TA Response: Disagree, in 1985 the TA established project controls to effectively reduce project delays and resultant increases in construction costs. The trends depicted on the attached charts (see Figures 1 & 2 attached) show that the majority of projects are now being completed within acceptable durations..

What is apparent, is that the budget estimates for construction administration were understated in the 1987 plan. Benchmarking guidelines are being initiated which will establish acceptable indicators to measure such activities as construction administration, design and TA labor. These guidelines will provide more accurate criteria from which to formulate realistic budgets.

IG Statement: (page 35 of IG Report)

"Construction administration costs increased by 17 percent during the 1987-91 period (see Table 12). The TA's cost estimates for construction administration are based on the number of work hours project managers, designers, engineers, inspectors and other personnel will require to administer capital projects. Construction delays increase the number of work hours required to administer contracts, thus increasing construction administration costs."

TA Comment: The conclusion formed by the IG may imply that all of these overruns (increases) are due to delays in scheduled completion. It is true that when construction durations are extended, construction administration costs will increase. However, data indicates that adherence to contractual schedules has improved steadily through the ten years of the current plans (see Figure 1).

IV. Stations

IG Statement: (page 13 of IG Report)

"The TA now expects its stations to be in good repair by 2009. In 1983 it expected them to be in that state by 1993."

TA Comment: In the 1986 Capital Needs Assessment, the Authority indicated that stations would not be in a state-of-good-repair until sometime after the year 2006. This is consistent with the current estimate of 2009 for state-of-good-repair in stations.

In addition, the station program as originally planned in 1983 and 1986 needed to be revised. New approaches were needed to manage complex station improvements as well as a system-wide station rehabilitation program. As a result of this reevaluation, the Authority has put in place a new station management organization to control station improvements planned as part of the station rehabilitation and station reconstruction programs.

IG Statement: (page 14 of IG Report)

"The Capital Program for the TA's stations has been one of the most clear-cut failures of the two Capital Programs. Though planned 1987-91 station commitments rose from \$458 to \$727 million between March 1987 and April 1991, the TA has not demonstrated its ability to substantially improve station conditions in a reasonable period of time at a reasonable cost."

TA Comment: (page 14, Second Paragraph)

The Authority has acknowledged the deficiencies that occurred in the Station Program area in the first two capital programs and has taken positive steps to remediate past deficiencies. Measures include: assignment of a single manager (Deputy Vice President) with responsibility for the entire Station Rehabilitation Program, establishing a group dedicated exclusively to the design of stations, creating a Program Planning and Development Area responsible for planning, budgeting, standards and guidelines, program development and project acceptance, increasing the support provided by scheduling and estimating personnel, and creating a Steering Committee of senior executives to oversee the program.

This increase in the level of management and control should ensure a more positive result for this program in the future.

(page 14, Last Paragraph)

Station condition surveys have been prepared for every station in the system. This information is utilized for establishing priorities for the program. The Station Rehabilitation Program has a unit with responsibility for program planning and development. This unit will identify stations to be rehabilitated and identify preliminary needs which will be utilized in scope development.

The dedicated design group will then develop detailed scopes, based on available information and site visits, before design commences, ensuring that complete and accurate information is available.

(page 17, Item 7)

As noted, full scopes of work are being developed prior to the commencement of design.

IG Statement: (page 14 of IG Report)

"Besides being over budget and behind schedule, the TA's Tunnel Lighting Program may be using an obsolete design. The MTA's independent engineer, O'Brien-Kreitzberg, reported that the mercury vapor lights being installed by the TA would have been more appropriate in the 1950s."

TA Comment:

Based on the information available, the TA has determined that the use of 50 watt mercury vapor lamps at 40 foot spacing is proper at this time.

However, the Authority, in cooperation with New York Power Authority (NYPA), has embarked on a program to test several types of light fixtures in our tunnels. Preliminary test results will be available by mid-1992.

After careful review of these results, a final determination as to the type of lamp, spacing etc. will be made.

The Transit Authority's Tunnel Lighting Design Criteria will be modified accordingly.

IG Recom.:

(page 17 of IG Report)

1) The TA must determine how much light is needed in its tunnels and design a system to provide such light. 2) In preparing the design, management should take into account the effects of glare on train operators. 3) Alternatives to mercury vapor lighting should be assessed.

TA Response:

1) Agree, the TA is in the process of finalizing tunnel lighting criteria to serve as the basis for designs. However, the National Fire Protection Association's Standard 130, Fixed Guideway Transit Systems, recommends that a minimum of 0.25 foot candles be provided for emergency lighting although no specific standards for rapid transit tunnel lighting exist. Therefore, based on both calculations and test results, present TA designs are meeting Standard 130.

- 2) Agree, the effects of glare on train operators have always been taken into account in designing tunnel lighting systems. For this reason visors are currently and have been in use since 1904 when the first tunnel lighting system was installed.
- 3) Agree, it should be noted that the TA has been and continues to investigate and analyze modern alternative forms of lighting. When a luminaire becomes available which will meet TA requirements and at the same time present more desirable features than the TA's current selection, it will be incorporated into the TA's tunnel lighting designs. As stated above, a program has been developed in cooperation with the New York Power Authority.

VI. Ventilation Plant Strategy

IG Statement: (page 14 of IG Report)

"Despite the importance of emergency ventilation fans, the 1987-91 Capital Program succeeded in restoring just five of them to good repair. Contracts to replace 19 more fans are scheduled to be awarded during the last quarter of 1991."

TA Comment:

This is the result of a conscious decision to delay fan plants until the completion of the Lexington Ave. plants which were designed as a pilot program for a typical vent plant. This action was taken early in the 2nd Capital Program, due to the extensive difficulties and problems experienced on earlier projects. With the completion of the Lexington Ave. projects in 1991, the Authority is proceeding with the award of 16 additional fan plant rehabilitations in 1991 and 1992. As a point of information, 2 of these fan plants will be replaced by a single fan plant which will result in a net of 15 fan plants being rehabilitated as part of the 87-91 program.

Furthermore, the Authority is proposing the carrying out of a comprehensive, total system wide study in order to formalize its strategy for the future and to create specific design criteria.

VII. Capital Assets

IG Recom.: (page 17 of IG Report)

The TA's Engineering and Construction Department should ensure that complete and accurate surveys of the condition of capital assets are undertaken during project planning and design.

TA Response:

Agree, the restructured design process, implemented in late 1990, includes complete and accurate surveys of the condition of the capital assets to be rehabilitated or replaced under a new design project.

During the scoping of the project, a team of engineers conduct a site survey on a visual basis to aid in the development of a simplified scope. Limits, approximate quantities, magnitude of the effort in terms of visual condition, etc., are determined in order to establish the basis for a rough preliminary estimate and proper planning of the project.

Once the simplified scope is completed, it forms the document upon which preliminary design will be based. At the onset of this phase of the design the preliminary engineering includes intensive instrument and engineering surveys in the field.

The instrument surveys, as required, will determine location and topography of the job site, while the engineering surveys will fully define the condition of the capital assets to be rehabilitated or replaced. Surveys continue on to the completion of preliminary design, if necessary to accurately define the parameters of the project.

VIII. Additional Work Orders

IG Statement: (page 15 of IG Report)

"From 1989 through May 1991, approximately 9 percent (\$4.2 million) of all TA additional work order charges were due to design errors and omissions. These problems probably would have been caught if a thorough design review had taken place.

The TA does not maintain accurate and comprehensive information on additional work order costs generated by designers' errors and omissions. Consequently, it is difficult to determine whether the TA has recouped the additional costs generated by these mistakes."

TA Comment:

A significant portion of design errors and omissions arise out of the initial scoping of the project and the extent of the preliminary engineering performed prior to final design. Another strong contributing factor to design errors and omissions is the lack of communication between the sponsor and the designer.

A restructured design process implemented in the final quarter of 1990 has addressed these problems. Simplified scoping, sponsor participation on the design team, and field intensive preliminary engineering up to 40% design, are some of the innovations included in the restructured process. This should keep design errors and omissions to a minimum.

With all preliminary engineering being accomplished with in-house forces, consultant design efforts will be much more defined. This should reduce all additional work orders (AWO's) including those arising out of design errors and omissions. In addition a Project Engineering Manager will monitor all the consultants design work.

The TA does keep comprehensive records on AWO's, including design errors and omissions. The problem in recouping costs from consultants who have committed design errors and omissions is proving culpability. While we may reason the consultant is in error, a rigorously defined scope without the benefit of performance specifications (extensive preliminary engineering), usually gives the consultant a way out, by allowing it to claim the scope gave no leeway to make a proper engineering decision.

Entering into litigation to prove a point against the consultant is usually counterproductive, placing the TA in a no-win position.

The restructured design process cited in the foregoing, should all but eliminate this kind of problem.

In addition, it is important to note that AWO's as a percentage of construction cash flow, have steadily improved. For example, for the years 1989, and 1990 the percentages of AWO's vs. construction cash flow were 4.8%, and 5.0%, respectively. The estimated percentage for 1991 is 4%.

IG Recom.:

(9, 10 & 11) (page 18 of IG Report)

- 1) The TA should seek ways to reduce the number and cost of additional work orders caused by design errors and omissions.
- 2) Similarly, more thorough design surveys should be undertaken to minimize additional work orders caused by unforeseen site conditions.
- 3) The TA should aggressively pursue recouping any extra costs incurred due to design errors and omissions.
- 4) The TA should establish an accurate and comprehensive database of additional work orders which should be backcharged to design consultants because of design errors and omissions. It should also track funds recovered.

TA Response:

In addition to answering the previous IG Statement on design errors and omissions, we have also addressed the above recommendations.

- 1) Agree, viewing the design errors and omissions picture again and considering the cost for this to be 9% of the overall TA AWO charges, we are looking at a design errors and omissions cost which represents less than one-half of 1% of the bid price. Although not high, the restructured design process (as previously explained under Statement/Issue) should substantially reduce this cost.

The number of AWO's is not necessarily indicative of good project management. If one concluded an average construction project with 200 AWO's that only consumed 1% of the contingency funding, it could be considered a highly successful design/construction effort. If the same project were concluded with only 5 AWO's consuming 15% of the bid cost, the design/construction effort would be viewed with suspicion. Additionally, the number of AWO's can be artificially controlled by grouping many different change orders into one AWO. This logic sustains the notion that it is the overall percentage cost of AWO's that should be of concern and not the numbers.

In this regard the TA has a good record, with overall AWO costs hovering at approximately 5% (the allowable contingency rate budgeted into the project cost). Considering that some portion of all AWO's result from project enhancements, developed subsequent to award of the construction contract (the restructured design process will eliminate this), the TA's overall AWO costs would drop well below 5%, an achievement that can be considered outstanding as compared to 10% plus average cost overruns of typical public sector contracts.

- 2) Agree, as previously explained field intensive preliminary engineering under the restructured design process will include thorough design surveys as part of the process. And, design surveys will continue on an as required basis, up to the end of preliminary design.

Those projects that will be constructed utilizing the created designs with the preliminary engineering process will afford the TA a much greater opportunity to prevent costs previously incurred due to design errors and omissions. The consultants performing the design under this process will have a clear understanding of the scope prior to making engineering decisions. The preliminary engineering documents given the consultant as part of its design package will define the project sufficiently to preempt improper engineering decisions.

- 3) Agree, recently we have negotiated a sizeable back charge from the Gun Hill Bus Depot Design Consultant.
- 4) Agree, regarding AWO reporting, a comprehensive, mainframe computer system has already been developed to monitor all AWO's related to Capital Projects. All data related to the AWO will be stored including all critical dates or milestones, costs and responsibilities. The Tracking Report will be enhanced to include all future recovered amounts due to design errors and omissions.

IX. Budget Process and Cost Estimating

IG Recom. 2: (page 16 of IG Report)

The TA should improve its process for preparing budgets and cost estimates to avoid underestimation, project deferrals, and large cost increases over the life of many capital projects.

TA Response: Agree, the Division of Cost Estimating and Controls established in 1986 is supported by professional staff, standards, procedures and pricing data base.

Historical data indicates that the Division's Engineers Estimate from 1987-1991 was within 10% of the low bid price. From 1987 through 1988, the Low Bidder was 10% higher than the Engineer's Estimate, while during 1989 through 1991, the Low Bidder was 10% less than the Engineer's Estimate due to the more competitive bidding environment.

Recently, the Independent Engineer, O'Brien-Kreitzberg completed a review of the TA's current organizational structure. Based on the IE's recommendations and an internal review, planned improvements have been initiated.

One of these initiatives will be the establishment of a Planning and Development Section to address the capital budget process and to control cost increases while fully integrating capital project planning with sponsor requirements. Authority objectives will be fully considered prior to designating projects for deferral.

X. In-House Labor Costs

IG Recom. 3: (page 16 of IG Report)

The TA should take steps to better track and control in-house labor costs. It should determine whether operating expenses were incorrectly charged to the Capital Program on any projects besides the one mentioned in this report. In addition, a procedure should be devised whereby the Rapid Transit Operations Department notifies the Engineering and Construction Department of the cost of service diversions before such diversions actually take place.

TA Response: Agree, the Information Systems Department in conjunction with the Office of the Controller has recently developed a new Job Summary Information System which provides detail costs of operating charges made to all capital projects. This new system reports actual charges of operating personnel for services provided to capital projects within the week of occurrence. This system will enhance Project Manager's response time in determining whether operating expenses are properly charged to the appropriate capital projects.

The Authority is significantly underway with the new development and implementation of new Capital Cost Control Procedures. These procedures require RTO, as well as other operating departments to provide estimates of service cost before service diversions and other activities take place. Additionally, as part of the proposed Capital Cost Control Procedures, the Authority is considering the development of standardized cost for flagging, work trains, crane operations, access and protection and other operating services necessary for capital construction work on the right-of-way.

IG Statement: (page 16 of IG Report)

"Besides being delayed by factors such as design changes, unforeseen site conditions, and changing priorities, capital projects have also been delayed by the intervention of outside agencies, including government and other transit agencies, not-for-profit corporations, and municipalities. Often beyond the control of the MTA operating agencies, such delays have affected the TA, the LIRR, and Metro-North.

IG Recom. No.13: (page 18 of IG Report)

The MTA and its constituent agencies should explore ways to minimize delays caused by outside agencies. Such efforts could include additional community outreach, advance planning with state environmental officials, and stronger commitments from funding partners."

TA Response:

Agree, the Transit Authority will explore with the MTA ways to minimize delays caused by outside agencies and will consider the recommendations suggested above.

IG Statement: (page 16 of IG Report)

"Policy Makers, including the MTA Board, Capital Program Review Board, and the Legislature, should assess whether the TA's schedule for achieving a state-of-good-repair, especially for such critical infrastructure and equipment as tunnels, fans, pumps, signals and yard track is appropriate given the Capital Program's principal goal of preventing a recurrence of the deterioration that characterized the system in the 1970s."

TA Comment:

The Authority is continuing its ongoing program achieve a state-of-good-repair on all system components especially for such critical infrastructure and equipment as fans, pumps, signals track and power facilities. Infrastructure investments proposed for the 1992-1996 Capital Program represent a 16% increase from the average 1982-1991 Capital Program investment. In addition, the current level of investment proposed in 1992-1996 is consistent with the Authority's ability to manage the construction of these investments.

IG Recon. No. 5a: (page of 17 of IG Report)

"MTA agencies should use sound cost/benefit methodologies and empirical data to justify proposed projects furthering purposes other than restoring the system to a state-of-good-repair.

MTA staff should carefully review all cost/benefit analyses to ensure they are both rigorous and well-documented with reliable data."

TA Response:

Transit Authority along with the input and review of MTA staff, has both analyzed and documented the cost/benefit of system improvement projects in the 1992-1996 Proposed Capital Program. A complete financial analysis of system improvement projects was conducted. This financial analysis included a capital investment analysis to show the net impact of a project on operating and capital budgets and a cost/benefit analysis which quantified the economic value of public benefits such as reduced crowding and travel time and conversion of auto trips to transit trips. In addition, the Authority ranked system improvement projects against Authority priorities so that the quantifiable financial aspects of a project are linked to Authority strategic objectives.

XI. Automatic Fare Collection

IG Statement: (page 13 of IG Report)

"There is little empirical support for the TA assertions that Automatic Fare Collection would boost revenue. The TA estimates that \$66 million to \$106 million in additional revenue will be generated annually by AFC. It used these figures to justify the \$420 million needed in 1992-1996 to begin implementation systemwide."

TA Comment:

Introduction

The total capital cost of the AFC Program is estimated at \$690 million (\$227 million through 1991, \$463 million included in 1992-1996 proposed budget). An additional \$92 million is also budgeted in the 1992-1996 Capital Program to fund several AFC-related items: the System-wide installation of AFC equipped electronic High Entrance/Exit Turnstiles (HEET); the additional hardening of fare control areas through the use of Anti-Fare Abuse Modules (AFAM) designed to be bolted to the basic AFC turnstile, and the procurement of up to 800 additional Automated Vending Machines (AVM) to further automate the fare media distribution process. Prototypes of this equipment will be tested early on in the AFC Program. If a sound business case can be made, the \$92 million in AFC-related funds will be used to procure and install the equipment more widely in the system.

The implementation of the base (\$690 million) AFC program is expected to yield revenue benefits in the range of \$89-109 million through the fare control improvements, passenger convenience and expanded pricing flexibility. As described below, this estimate is based on extensive market research, pricing analysis, thorough subway and bus revenue control studies plus pilot tests of prototype equipment as well as the experience of other transit properties throughout the world.

Rapid Fare Control Improvements - \$41 million

In the Summer of 1988, the Authority undertook extensive field surveys to measure the level of fare abuse at each fare control area on the Rapid System. These surveys showed that approximately 5.5 percent of total ridership of 60 million passengers were evading fare payment by illegally entering the system through exit slam gates, over low railings, or by slipping through the turnstiles.

To address this problem, in the Fall of 1988, three Cubic prototype electronic anti-fare evasion turnstiles were installed at 18th street on the Broadway/7th Avenue line. In addition, this fare control area was equipped with full height railing and service gates. (Alta prototype equipment was installed at one control area in the Times Square station but because of the many (16) locations in this complex, ridership and revenue effects were difficult to isolate). Several methods were used at 18th Street to observe changes in fare abuse patterns including on-site surveys, CCTV video recordings and analysis of "before and after" registration counts over a six month period. The results of this test at 18th Street showed that, when confronted with physical fare control improvements, a total of 60 percent of former fare evaders paid to enter the system - a nine percent increase in fare paying ridership at this location. This outcome was comparable to those observed at a pilot fare control program also conducted in 1988 at three Lexington Avenue stations: 103rd Street, 110th Street and 116th Street. During this pilot, secure turnstile vaults and slam gates, coupled with a 24 hour police presence produced similar revenue and ridership results to the 18th street pilot.

These results were extrapolated to the system as a whole, as follows: 60 million evaders x \$1.15 fare x 60% prior evasion/fare payer conversion = \$41 million.

Our review of recent AFC installation at transit properties throughout the world also demonstrated the potential impact of improving station passenger flow control. Specifically, the implementation of AFC on the London Underground resulted in an increase in fare paying passengers of approximately 10 percent. This compares with our projected Rapid revenue increase of \$41 million due to improved fare controls - which represents less than 1/2 percent of our current subway revenue base.

Bus Fare Control Improvements - \$23 Million

The AFC Surface revenue benefit estimate was also based on actual data review and observation. In 1988 the Revenue and Surface Departments conducted a survey of bus to bus transfer activity. Among the findings of this review were that transfer stock is significantly over-produced for service needs with over 580 million transfers printed annually to accommodate an estimated 60 million bus passengers using transfers. In summary, the Report found that the difficulty of manually disbursing, securing and accounting for transfers has resulted in a leakage of at least 20 million unaccounted transfers both at the depot and in circulation on buses. This leakage, in effect, represents free rides to passengers who obtain these transfers either through a presumed transfer resale network or from well meaning customers who distribute unneeded transfers to other passengers.

Our AFC Program calls for an integrated bus fare collection system including a new state-of-the-art farebox with a read/write device plus an electronic transfer dispensing machine on each bus. These transfer devices would issue transfers only upon payment of a full fare by a passenger, thereby eliminating the potential for theft of transfer books on buses or in the depots. In addition, each transfer would be accounted for electronically and transfers in circulation would be limited to actual use. Finally, used transfers would be eliminated.

The automation of transfer distribution and issuance is expected to reduce abuse of the media by \$23 million annually calculated, as follows: an estimated 20 million of transfer abuse x \$1.15 fare = \$23 million.

Convenience and Pricing Flexibility \$25 to \$65 million

The calculation of convenience and pricing flexibility revenue benefits were derived from our market research as well as rigorous pricing analysis. Increased passenger convenience is difficult to quantify, yet given the flexibility and potential availability of the AFC fare card, our projected one percent increase in ridership and thus (\$15 million) in added revenue appears conservative. The introduction of AFC will allow for the expansion of Authority fare media distribution beyond the token booth to both in-system (vending machines) and out-of-system outlets (retail establishments and mail and employee programs). Our market research as well as other available studies support a potential market penetration rate for an undiscounted fare card to be at least 60 percent. Based on these factors, we expect a one percent ridership and revenue increase to be achievable.

The almost unlimited pricing flexibility potential of the new fare card is expected to yield revenues in the \$10-\$50 million range.

Our current token-based system constrains the Authority to a flat fare with separate payments for intermodal (subway and bus) travel. The possible fare options with AFC are almost limitless and include peak/off peak, multi-ride, intermodal, weekend, commuter and special event pricing. The use of variant pricing to meet customer demand is successfully used on transit systems throughout the world to promote increased ridership and maximize revenue. Our own in-house studies show that creativity using the fare card's pricing flexibility can significantly increase the Authority's revenue base while keeping ridership constant. In addition, the AFC fare card provides the needed technology to begin the integration of the various MTA services from a fare payment standpoint. Providing a seamless region-wide transit system, to our customers is a critical element in effectively marketing MTA services as an alternative to private auto and van use.

We also intend to exploit the marketing features of the AFC fare card to the greatest extent possible. In Japan, for example, rail systems use elegant advertising on their fare cards generating significant additional revenues while making their media virtually a "collector's" item among passengers.

(0006s:1-17)

ADHERENCE TO CONSTRUCTION SCHEDULE

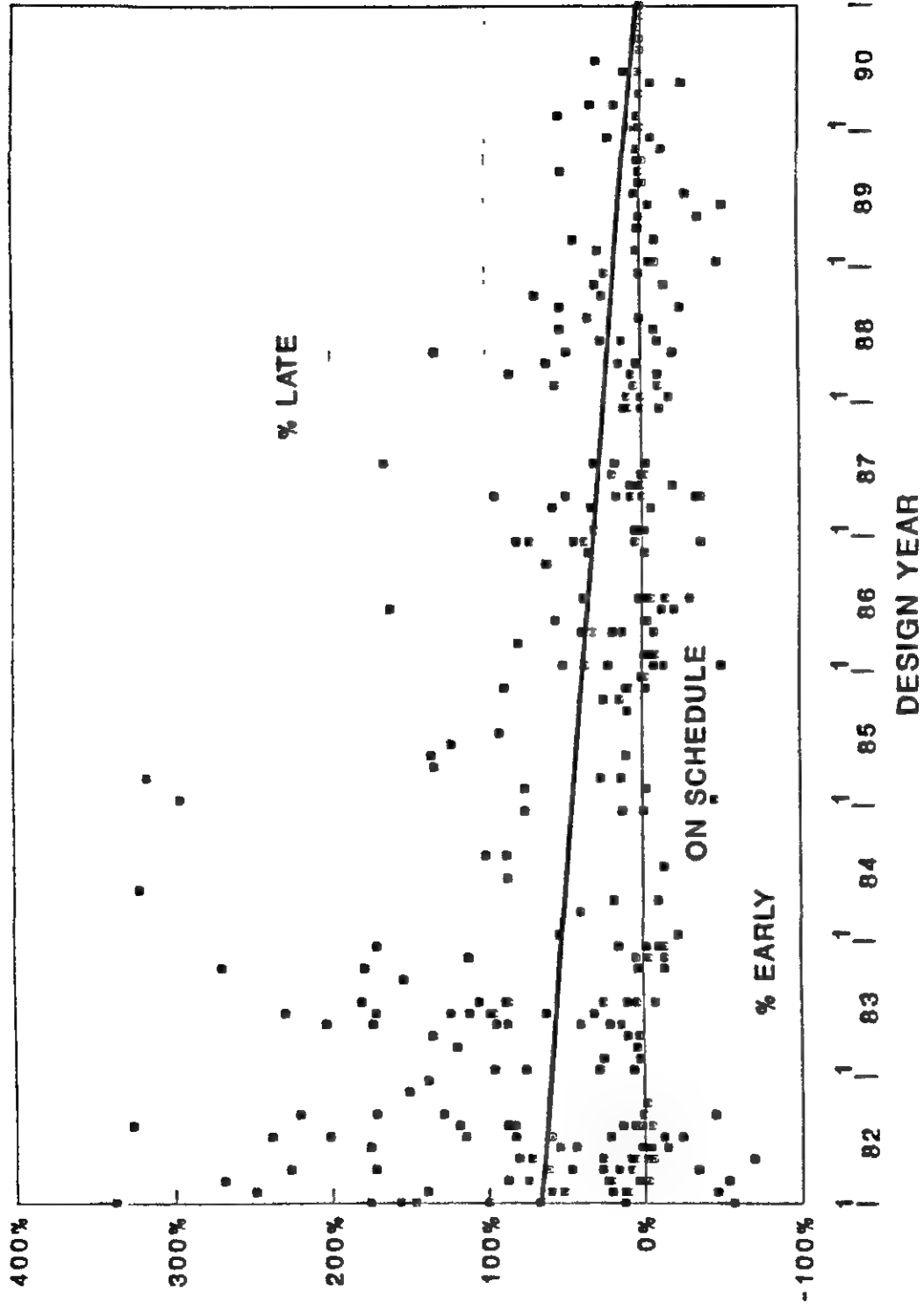


FIGURE 1

CONSTRUCTION DURATION VARIANCE

1982 - 1990

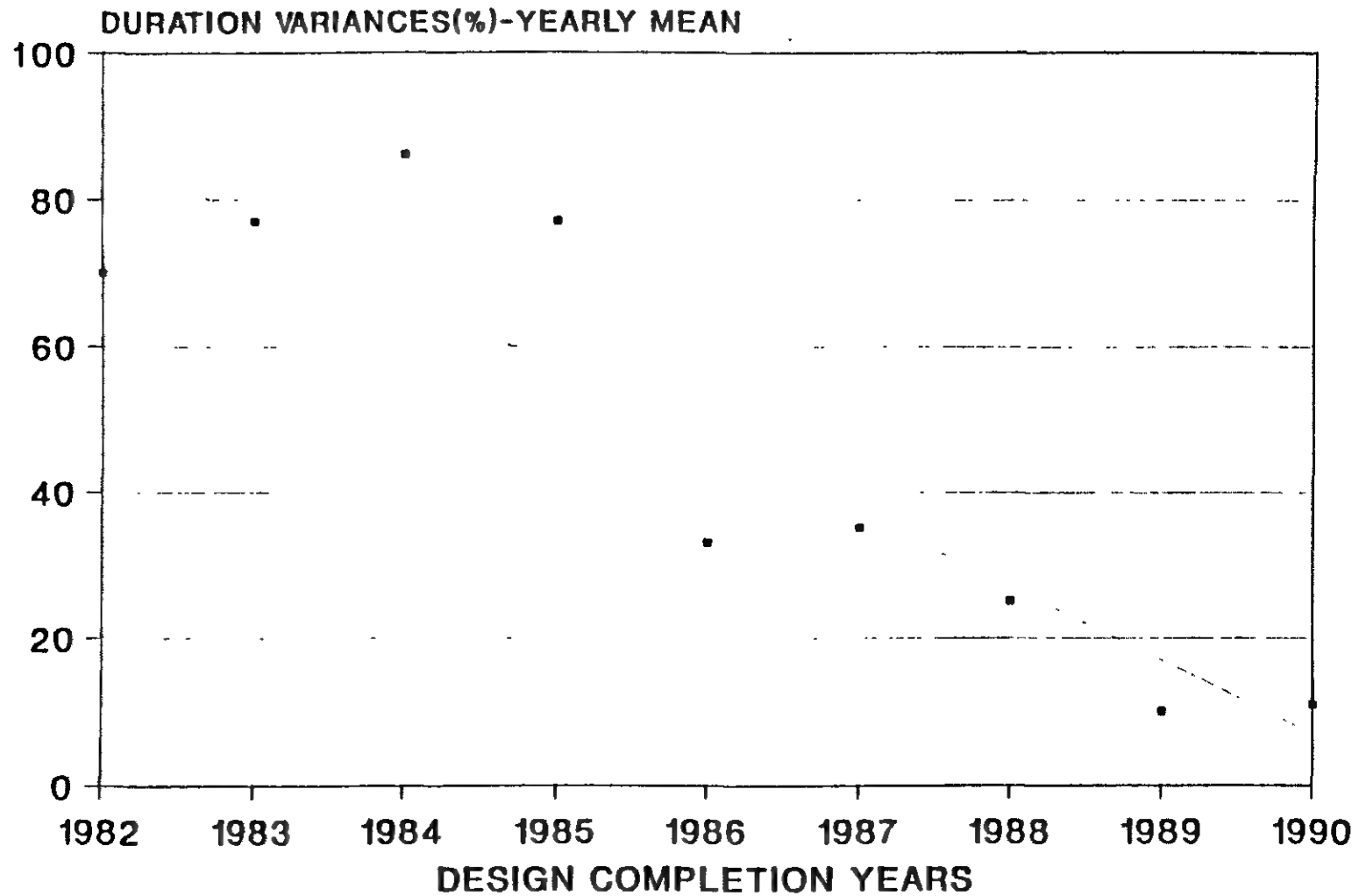


FIGURE 2

APPENDIX C

LONG ISLAND RAIL ROAD RESPONSE TO DRAFT REPORT

Date September 20, 1991
To: Peter E. Stangl, Chairman
From: Charles W. Hoppe, President
Re: Draft Report on the IG's Review of the MTA Capital Program

The subject draft report has been reviewed by our Capital Program, Capital Budget and other cognizant personnel. We previously discussed and resolved a number of changes with the Inspector General's office to clarify, update or correct certain data in the draft report. None of the changes effect the overall conclusions or recommendations of the report with which we basically concur.


We believe the report offers a comprehensive summation of what has been accomplished to date toward the original objectives of the Capital Program, the state of our Capital plant today and our current capabilities to continue the Program into the future.


Charles W. Hoppe
President

cc: J. C. Bennett
N. DiMola
W. Goldstein
S. A. LaRocco
R. J. Warncke

METRO-NORTH RESPONSE TO DRAFT REPORT

DATE September 17, 1991

TO Peter E. Stangl 

FROM Donald N. Nelson 

RE INSPECTOR GENERAL DRAFT AUDIT REPORT, MTA/IG 91-12,
"Review of the MTA Capital Program", dated 8/23/91

Forwarded herewith is our response to the Inspector General's draft audit report.

The report is a comprehensive and reasonably accurate assessment of Capital Program progress to date. It presents a fairly balanced view of the 1982 - 1991 Capital Program's successes and shortcomings. The report also properly raises issues which need to be addressed while considering future capital requirements. However, several items in the report deserve comment and clarification.

Our most significant concern is the report's conclusion that Metro-North and other agencies did not reach a state of good repair in 1990 as originally planned because cosmetic concerns were frequently emphasized over structural integrity when selecting and prioritizing projects (see page 245).

We believe this conclusion to be overstated. There are many critical factors which Metro-North is required to consider in project selection, among which are structural integrity and aesthetics.

The report does go on to state that safety, security and a pleasing environment are critical objectives in addition to structural integrity. However, there are also other important selection criteria which have been and should continue to be used such as lowering operating costs, reduction of operating budget subsidies, increasing system reliability and improving on-time performance.

We believe that all the above mentioned selection criteria are important in the development of the best possible mass transportation system for the New York region. The report would present a more balanced and realistic assessment of Capital Program achievements if the requirement to address many and various objectives was more thoroughly represented.

Other comments and clarifications are provided on the Attachment.

DNN/raf
Attachment
cc: N. DiMola
H. Permut
W. Aston

COMMENTS TO MTA/IG 91-12, REVIEW OF THE MTA CAPITAL PROGRAM

- 1) To clarify page 3, 3rd paragraph, MNCR expects to have the entire NY State portion of the Railroad in a state of good repair by 1996 except for Grand Central Terminal and bridge structures.
- 2) MNCR concurs with the cost/benefit analysis recommendations on item 5, page 17 and has utilized this approach in developing the proposed 1992-96 Capital Program.
- 3) MNCR concurs with the recommended methods on page 18, item 13 to minimize project delays caused by outside agencies and has utilized this approach in developing the proposed 1992-96 Capital Program.
- 4) On page 165, 3rd paragraph, in addition to the causes of project delays and cost overruns already listed, outside factors, such as governmental agencies and community groups were key reasons why several MNCR projects were not completed on schedule and within budget.
- 5) The reason given on page 166, 3rd paragraph for postponing construction of Yankee Stadium Station requires clarification. The postponement was because a long-term lease was not completed between the City of New York and the Yankees. This comment also applies to the 1st paragraph on page 178.
- 6) To clarify page 166, 6th paragraph, 8 of the 14 1989 parking projects referred to were deferred or delayed because of municipal budget limitations, loss of eligibility or governmental decision.

To partially compensate for this loss, 4 more parking projects were initiated in 1990. It should be noted that 9 parking projects were also completed prior to 1989.

- 7) On page 174, the 2nd & 3rd paragraphs, plans to procure new rolling stock in the 1992-96 Capital Program have been revised. MNCR now plans to maintain the ACMU 1100 Series cars currently in service on the Hudson & Harlem Lines.
- 8) In the 2nd paragraph on page 185 which discusses the New Hamburg Bridge, in addition to the information in the report, it should be noted that the budget has increased as a result of actions taken by the U.S. Coast Guard.
- 9) On page 187, 1st paragraph, which discusses the West Shore Line Study, it should be noted that MNCR has decided to defer this capacity improvement study because of other higher priorities. This comment also applies to the 1st paragraph on page 238.

D. Nelson memorandum to P. Stangl

September 17, 1991

- 10) The 2nd paragraph on page 238 requires clarification. The Port Jervis/Pascack Valley study has been delayed due to concerns on the part of NJ Transit.
- 11) On page 246, 1st paragraph, it should be noted that MNCR anticipates that only bridges will require until 2011 to reach a state of good repair. The balance of the NY State system is expected to reach a state of good repair by 1996 except for Grand Central Terminal. The New Haven Line is expected to be in a state of good repair by 1996 except for shops which should require until 2006.

APPENDIX E

INSPECTOR GENERAL'S COMMENTS TO MTA RESPONSE

We are pleased that MTA Chairman and Chief Executive Officer Peter E. Stangl found our report to be a "fairly accurate appraisal of the progress made by the MTA in meeting the objectives of the first two Capital Plans." We offer the following observations related to Mr. Stangl's specific comments, as well as those of the MTA Capital Program Management Department, the TA, LIRR, and Metro-North.

The TA and the MTA responses to our report state that our conclusion that significant delays occurred in achieving a state of good repair is "off base" because it is based on milestones set out in a "hastily prepared" 1980 MTA study. We believe it was appropriate to use that study for a number of reasons. First, the 1980 study was not the only benchmark used to assess program performance. As Table 2 of the report shows, we examined timetables for achieving a state of good repair prepared by the MTA in 1983, 1986, 1990, and 1991. Indeed, while we discussed the 1980 report, the first schedule we actually used to gauge progress toward a state of good repair was prepared by the TA in late 1983. By then, the Authority should have had enough time to prepare accurate projections.

Second, using later estimates of how long it would take to reach a state of good repair would not have changed our basic finding. The TA's assertion that "the findings of the 1986 assessment are generally consistent with the current estimates," is incorrect. In 1986, for example, TA management projected that its emergency ventilation fans would reach a state of good repair in 2001. In March 1991, the target was pushed back to 2006 and in September 1991 it was again pushed back, this time to 2007.

Other programs had similar delays. In March 1986, the TA expected its power system to be in good repair in 1999; by September 1991, the date had been pushed back to 2007. The date for shops went from 1997 to 2006, yards from 1998 to 2015, and depots from 1992 to 2000. Moreover, we are in fact skeptical that the TA will be able to achieve a state of good repair in a number of categories -- stations, line equipment, yards, and depots -- within the time frame it has announced.

Finally, it is important to remember the significance of the MTA's 1980 proposal. As a result of that proposal, the Legislature was told that if a specified level of funding were made available, the MTA would achieve specific results within a specific time frame. It would not be an exaggeration to state that these 1980 projections provided the basis for the ongoing MTA Capital Program.

Now, the MTA suggests it should not be held accountable for these early projections because they were hastily done. However, MTA officials did not say in 1980 "give us \$14 billion, but our plan was hastily done so don't hold us to it." In essence, though, that is what they are saying now. This position jeopardizes the public's trust that such plans are meaningful and well-supported. Public officials must be held accountable for their statements, especially when they provide the basis for extraordinarily large public expenditures.

In response to our finding that the benefit-cost analysis underlying the TA's decision to implement AFC lacks empirical support, the TA describes its analysis and asserts that: "A complete financial analysis of system improvement projects was conducted." This assertion ignores our finding and is not true.

The "studies" cited are simply the ones described in our report. After reviewing these studies the first time, we concluded that "there is little empirical support for the TA's projections of increased revenue." Nothing in the TA's response persuades us to change our position.

The TA's response to our discussion of major policy changes in other program areas -- particularly depots, shops, yards, and stations -- tends to focus on the reasons for those changes. The main thrust of the TA's comments is that these changes are improvements and should not be criticized. These comments misperceive the nature of our discussion of policy changes. We were not criticizing the new directions taken, but were pointing out that these rather abrupt changes reflect longstanding planning, budgeting, and design problems which must be addressed.

We were astonished, for example, that the TA's station program was seven years old before the TA assessed the structural condition of its 469 stations. Similarly, the depot program has undergone repeated changes because the TA did not ascertain that some facilities were in such poor shape that they needed immediate attention. And the TA is only now starting to develop a systemwide fan strategy even though the ventilation fans are an important safety-related component of the subway system.

The TA's failure to assess the condition of its facilities and equipment as an integral part of the capital planning process is just one of the shortcomings we identified. Another serious problem is that it has consistently underestimated capital program costs. As a result, many of the projects included in the 1987-91 Capital Program were eventually deferred because available funding was eaten up by cost escalation in construction projects already underway. This is one of the primary reasons the TA has fallen farther and farther behind in its efforts to achieve a state of good repair. The TA has indicated that it is taking steps to address this problem. We applaud these efforts and hope they will be successful.

We believe the principal challenge is to prepare a capital revitalization strategy based on a sound assessment of need and realistic estimates of what projects will cost. We anticipate that the recommendations in our report will help the MTA and its constituent agencies achieve this goal.